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# U.S. ARMY

# MEDICAL SUPPLY SERVICES SCHOOL, St. Louis

# TEXT BOOK

## VOLUME 4

## OPTICAL

### SECTIONS I TO XVII

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# SECTION I

# HISTORY OF OPTICS

# THE HISTORY OF OPTICS

The history of optical science is necessarily closely related to the history of glass. It is the general opinion that glass was first put to practical use in Egypt about the year 3000 B.C. in the form of glass beads. However, there is a divergence of opinion as to whether Syria, Egypt, Ceylon, or China can rightfully lay claim to its discovery. With the progress of glass-making came transparent glass about the year 600 B.C. In 306 B.C. there is a record of "mirrors of glittering glass" having been carried in a procession in India. The first record of glass being used as an aid to vision in the form of spectacles comes late in the 13th century when the writer Meissner, mentions that old people derived advantages from spectacles.

So far as we can judge man's interest in optics started with a drop of water. Take a small piece of glass. Stick a bit of type printing on the back of it so that you can read the print through the glass, over the printing spread a little white vaseline very thinly. Then carefully put a small drop of water on the vaseline, over the type, the size of the letters increases; they are magnified.

Probably primitive man saw this phenomenon countless times and thought nothing of it. A drop of rain on a dry leaf will enlarge the veins of the leaf and make them stand out. A rounded drop of water on a tiny grain of sand makes it appear like a small pebble. Any number of such manifestations man must have seen. Finally it appears to have dawned on him that there was a connection between the rounded form and the ability to make things appear larger than they were; because there is evidence that the ancients used round bowls or flasks filled with water for this very purpose. Such articles have been found in the ruins of early civilization; and from the same period came examples of beautiful engraving, so fine that they could not possibly have been done with the naked eye, jewels accurately cut and decorated in minute patterns. In some of the earliest writings we find reference to the fact that a globe filled with water serves as a burning glass and may be used to focus the suns rays so as to start a fire.

A spherical vase filled with water magnifies an object held behind it, but it is also likely to distort the image. At some early date man discovered that a piece of glass curved outward on opposite sides, like the shape of a lentil, gave a far more satisfactory image. So he named such glasses after the lentil, and called them lenses.

Lens shaped crystals and pieces of glass have been found from time to time in uncovering the relics of departed civilization, some in tombs of Egypt, some in the ruins of ancient Greece. Attempts have been made to establish these as the forerunners of eyeglasses; but probably they were nothing more than jewels and articles of personal adornment. Legend has it that the Emperor Nero had defective vision and used a large rounded emerald when viewing the fights of the gladiators. However, it must be concluded that although the magnifying power of the lens was known thousands of years ago, its use as an ordinary seeing aid or as an attempt to correct faulty vision came much later.

With the fall of the Roman empire the art of glass-making declined. There is little information available concerning the glass industry between the Roman period and the 13th century. At this later date, glass-making was revived first in France and then in England. But it was not until the 16th century that glass was produced in any quantity in England, France, or Germany.

It seems probable that the first attempt at making optical instruments was the invention of spectacles. As near as can be determined these were introduced late in the 13th century. The first authentic mention of such a use of lenses is the statement in the writings of Meissner, who lived around 1240 to 1280, that old people derived advantage from spectacles.

# THE HISTORY OF OPTICS

In the archives of a French Abbey, the statement is found that in 1282, a French priest Nicholas Bullet, used spectacles when signing an agreement.

In a sermon delivered on February 23, 1305, Giordano da Rivalto asserted that it was "only twenty years since the art of making spectacles was discovered." But the first known description of the use of convex lenses as an aid to vision had already come from the pen of Roger Bacon, English monk and philosopher, in 1266. And from Bacon's time on there are frequent references to spectacles in various manuscripts that have been preserved to this day.

Marco Polo, greatest of medieval travelers and whose exploits are said to have started Christopher Columbus on the journey that brought him to the shores of America, wrote in 1298, that spectacles were extensively worn by the nobility in China. Research leads to the belief that these glasses had no magnification and corrected no optical defects. They were merely worn because of the dignity and poise they gave.

Salvino d'Armato is reputed to have invented spectacles in 1285. A tombstone in the church of Santa Maria Maggiore in Florence bears the inscription, "Here lies Salvino d'Armato, called Armati of Florence, the inventor of spectacles. God pardon him for his sins."

The first picture in which spectacles are shown on a person is that of Cardinal Ugone painted in 1360 by de Modena. It now hangs in the church of San Nicola in Treviso. It is noted that all early references to these seeing aids are in connection with churchmen. Yet this is natural, for in those days they were the only ones who could read or write.

Spectacles remained uncommon and of comparatively little interest to the world until after the invention of the printing press. Interest gained rapidly after the advent of printed material and by 1600, lens grinders could be found in nearly every town of importance in Europe.

It was just about this time that the telescope was invented. The first telescope appears to have been invented by one of two Dutch spectacle-makers, Zacharias Janson or Franz Lippershey. Gallileo, having heard of this Dutch toy, was led to experiment with a combination of two lenses and he soon succeeded (1609) in making a telescope with which he made a number of renown astronomical discoveries.

Much as ancient astrologists had learned about the stars, the telescope revealed that the naked eye had told but the least part of the story. Astronomy became an important study. The question created stimulated the further study of mathematics. The increasing demand for more accurate observations resulted in the invention of the achromatic telescope objective in 1757. Soon after the invention of the telescope the Dutch naturalist, Leeuwenhoek, invented the microscope (1673). The increasing demands of the scientific field coupled with the wider education of the public and the increasing demand for spectacles soon brought on great improvements in the methods of manufacture and the standardization of ophthalmic glass.

In 1593 J.B. Porta explained the action of the concave lens on a near sighted eye and tells of later grinding plano concave, plano convex, double concave and double convex lenses in Venice.

About fifty years after Charles I granted a charter to the Spectacle Makers Guild of England, a document that dates back to 1629, an English lens grinder

invented the method of grinding a number of lenses together on one block. This increased the production and consequently decreased the cost of spectacles. At this time spectacles cost about $100 which was equivalent to $400 or $500 today.

For many years spectacles lenses were all spherically ground. The theory for making them depended entirely on only one of the principles of seeing; namely that it is easier to see large objects than small ones. The difference between one pair of spectacles and another was merely a matter of how much each magnified. A person tried on various pairs of spectacles until he found a pair which increased the size of things enough to distinguish them, even though they might still be blurred and distorted.

In 1825 Sir George B. Airy demonstrated that astigmatism can be corrected by cylindrically ground lenses. But his discovery was a little ahead of times. The mathematics of lens grinding was not yet very well understood. There are so many forms and degrees of astigmatism that it proved a difficult fault to correct with the knowledge and information then available. So it was not until about thirty or forty years ago that the correction of astigmatism became common.

In 1784 Benjamin Franklin invented the first bifocal lens, now known as the split bifocal. Finding the use of one pair of spectacles for distance and another pair for reading most inconvenient, he split the lenses in half horizontally and fitted one half of a distance lens and one half of a reading lens together, inserting them in one frame. This led to the development of the cement bifocal. The cement bifocal is made by cementing a thin supplementary lens or segment to the main distance lens with Canadian balsam. The segment is made of crown glass and is applied to the inner spherical surface of the distance lens. Therefore, one surface of the segment must be ground to the same curvature as the inside spherical surface of the main lens. The other surface of the segment is ground to give whatever reading addition is called for.

The terms "flint" and "crown" as applied to optical glass were derived in a very interesting way. Of all the terms used in conjunction with optical glass these two seem to be the least clear in the minds of persons generally interested in ophthalmic lenses.

Flint glass obtains its name from the fact that when lead was first introduced as glass-making material, for the production of tableware and the like, ground flints were used as the source of silica in its composition. Today flint glass is that which contains lead oxide in its chemical structure.

The origin of the word "crown", to describe glass, is more obscure. It was originally applied to the type of window glass made in the shape of discs, the center of which formed a bullion such as is still seen in the 17th and 18th century houses in England. Prior to the introduction of glass especially made for ophthalmic lenses, thick pieces of crown glass were used for grinding lenses and those so produced were called "crown" lenses. At the present time the term "crown" is generally considered as applying to glass containing silica, soda or potash and lime, when such glass is used for ophthalmic lenses or optical instruments.

Glass is made by melting or fusing, at high temperatures, of three principle ingredients:

1. An acid ingredient - sand, which is known chemically as silica.
2. An alkaline ingredient - soda or potash or a mixture of the two.
3. One or more earth materials - lime, lead, barium, zinc, etc.

The physical qualities and color of glass vary according to the ingredients used in making it, according to the proportions in which these are mixed, and according to the process of manufacture. There are many kinds of glass from "bottle" glass which frequently has a green or yellow color due to impurities, to beautiful plate glass, cut glass, glass from which imitation jewels are made, optical glass, and ophthalmic glass.

Optical glass is that used in making lenses for optical instruments in general; more particularly telescopes, microscopes, and so on. Ophthalmic glass is that used in making eyeglass lenses.

There are many peculiar and intricate problems to be solved in making both optical and ophthalmic glass. Three of the most important requirements are purity, uniformity, and refractive index.

Impurities in the ingredients that go to make up a batch of ophthalmic glass are likely to result in objectional color. Lack of uniformity in any portion of the finished lens would result in an incorrect bending of the rays of light passing through it, throwing the image out of focus. And, as has already been explained, the density of the glass itself determines its refractive index.

Purity comes from the careful selection of raw materials. Uniformity results from scientifically correct and accurately controlled manufacturing methods. Refractive index depends on the proper proportioning of the right kinds of materials.

Few people realize how intricate the making of a pair of spectacles really is. We consider the making of fine watches a great art; and so it is. But any skilled mechanic can learn to make a good watch. Making eyeglasses, on the other hand, requires a vast scientific and mathematical knowledge as well as technologic skill that makes watch making seem more child's play in comparison. The examination given by the refractionist discloses how much and in what direction light rays must be bent in order to correct the deficiency of the eye. The lens provided must meet this requirement, exactly. In the final analysis it is the lens that is the corrective agent.

If the bending of the light rays by the lens depended on a single factor, it would not be difficult; but it depends on several factors. It depends, for example, on the curvature of the front of the glass, on the curvature of the back of the glass, on the refractive index of the glass, and the thickness of the glass. All of these can be figured out by higher mathematics, but even then unless the glass is perfect and uniform through out, all of these calculations will be wrong. Even with all the precautions of scientific knowledge and modern production precision, often no more than two percent of a batch of glass finds its way into lenses.

The raw materials for good ophthalmic glass come from the four corners of the earth, sought out on the basis of their purity. Probably close to one eighth of the earths crust is silica, sand, the main ingredient; but there are few spots where sand of sufficient purity and the right qualities, for this particular glass, can be obtained. In America, the choicest sand comes from a little section of Pennsylvania and a small section of West Virginia. The potash comes largely from Germany. The soda comes from South America except that sodium carbonate which is prepared by chemical process from salt obtained in New York state. Lime comes from Ohio and Kentucky; lead from Missouri; barium from West Virginia; zinc from New Jersey; and antimony from China. It is not that these various ingredients can be found only in the location mentioned; it is necessary to go to these various places in order to get materials best suited for ophthalmic glass.

A year before a batch of glass is to be made, a melting pot is made; because it takes a year for these pots to age. Before the pot is used it is glazed with scraps of previously made optical glass so that no impurities can be picked up from the pot.

After the carefully selected raw materials have been received and are carefully inspected and checked, they are weighed out according to formula; thoroughly mixed; and put into the glazed clay pot. A small amount of glass scrap of the same type, called cullet, is added; because, having already been melted once, it softens more quickly than the new materials and thus aids in carrying out the melting and fining operations.

The pot and its contents go into the melting furnace where the temperature is raised to as high as 2600 degrees Fahrenheit. Any ordinary thermometer would melt under this terrific heat, so, to control the heat of the pot and its contents, a remarkable optical thermometer is used. This instrument measures the intensity of the light given off by the molton mass and thereby indicates the temperature.

It takes seven or eight hours for a batch to melt. Then comes the fining process which takes another seven or eight hours. During the period, the batch is thoroughly mixed to assure uniformity, and the bubbles are removed. To help the bubbles rise and escape, the batch is stirred rapidly shortly after the melting is completed. Then, after the bubbles have been removed and the glass is at the highest temperature, the practice is to stir the glass during the preliminary cooling in the pot, first with a rather rapid motion; more slowly as the glass thickens.

Six to seven hours of controlled cooling brings the glass to a consistency of thick molasses or taffy. The pot is then taken from the furnace; the glass is poured out on a large table and a roller passes over it, rolling it down to the desired thickness, usually about three-eighths of an inch. The sheets become hard, solid glass almost immediately, but they are still very hot. And, because glass is a poor conductor of heat, they are then removed to an annealing furnace so that they can be cooled very slowly. Otherwise, the outside would get cold before the inside of the sheet. The glass would become brittle, optically irregular and full of internal strains. Ophthalmic glass is usually given eight hours for cooling but glass for some of the huge telescopes requires as much as a year to come down to room temperature.

When properly cooled, the sheet of glass is cut into little squares called blanks, each one a little larger than the size of an eyeglass lens. Then starts the inspection, rejection, and selection that may eventually reduce a six hundred pound batch of ophthalmic glass to no more than twelve pounds of finished lenses. At this very first stage, one out of four blanks is rejected, on the average.

After this inspection and sorting according to weight by a delicately accurate, intricate machine, those blanks which so far are deemed satisfactory for lenses are heated, moulded into the approximate shape of the lens desired, and given a final and very complete annealing. Annealing is a slow, definitely controlled cooling process which "draws the tempor" from the glass. It not only removes brittleness, it also reduces tension and strain within the inner structure of the material.

Next comes grinding. A number of pressings are mounted on a block by being cemented to it with pitch. Then a shell of the exact desired curvature fits down against the pieces of pressed glass. Emery is placed between the glass and the shell, and the shell is moved with a rotating and oscillating motion that grinds the

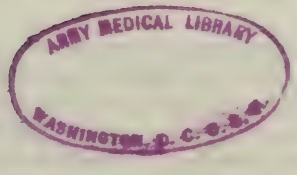
glass away until it is curved exactly the same as the master shell. After grinding, the surface is polished in the same way by substituting fine rouge for emery.

If the reverse side of the lens is to be curved, the pieces of glass are remounted with the other side up and this is ground in the same way, using whatever curvature is called for, which may or may not be the same as that of the first side.

Washing and rigid inspection follow. The lenses are lacquered to protect their surfaces until completed. They have still to be cut and edged to the desired size and shape.

All told there are some forty-five inspections before good eyeglasses lenses are finally approved; the final inspection is made by means of an instrument which checks up on that vital question of whether they actually bend the rays of light exactly as desired. This instrument is called a lensometer, vertometer, or other name as the different manufacturers may designate.

Today, each lens is individually designed to correct some particular optical defect or condition. The refractionist of today makes a painstaking examination and determines among other things, the strength and percentage of vision in each eye, the exact lens or combination of lenses necessary to give clear, comfortable, and efficient vision. The proper correction of refractive errors in vision depends on the lenses used. To insure the best results with eyeglasses, the lenses themselves, should be of the best quality and workmanship. Interpretation of the prescription, determination of the precise formula for the lenses needed in each case, and the grinding of the lenses to that formula, are the responsibilities of specialists who have had years of training and possess an exacting ability.



# SECTION II

# HISTORY OF ARMY PROGRAM

During the last War the need of spectacles for military personnel was not given serious attention, until these men were in the actual theatre of operations. Therefore, it was not until the troops arrived in France that the need of an Optical Repair Section manifest itself. This Optical Repair Section was established in Paris directly under the supervision of Colonel Edmonds assisted by Captain Bohling with the enlisted personnel strength of approximately twenty men. Here, at this shop, they set up a complete optical shop, surface grinding, cutting, edging and assembling, where they were able to dispense spectacles using flat lenses and steel rimmed 40 and 42 round eye frames. The delay in filling prescriptions was considerable as the stock of finished lenses was inadequate for their needs, which necessitated considerable surface grinding. Nevertheless, many pairs of glasses were made before the Armistice was signed, although at that time there was a back log of some 20,000 requisitions for glasses.

In 1941, when it was decided that the Surgeon General's Office would be responsible for correcting the visual deficiency and maintenance of the spectacles, plans were formulated for a number of Mobile Optical Repair Units. These units were to go overseas and each unit would service an Army of 200,000 to 400,000 troops. Equipment and materials for this unit were contained in a standard 2½ ton truck and a 1 ton trailer. They were made by the three leading optical manufacturers using their own type of edging stones, cutters, markers, etc., consequently, each unit varied from its fellow depending on the manufacturer. Containing such articles as frame cleaners, lens hardening units, drilling machines, etc., the equipment in these Mobile Units was very complete but in many instances unnecessary.

In the Fall of 1942, plans were set forth to standardize and simplify the equipment, but first the prescribing of the glasses, and foci of powers prescribed had to be kept in the simplest form, therefore, it was decided that only one type of spectacle frame would be issued. This frame was a white metal frame, in a P3 shape, Fulvue style, eye sizes from 40 to 46. Further, it was decided that no other types of spectacles would be serviced overseas and that all Commanding Officers of Mobile Units would be so instructed. Also, the Advisory Board decided that no prescriptions would be written in 1/8th diopters and that the prescribing of spectacles in which the power in the strongest meridian was 1 diopter or under would be discouraged.

A stock pile of many hundred of thousands of glasses were set up. The range of foci was increased so that Mobile Units could service all but approximately 5% of the prescriptions that they received. This necessitated considerable work for the manufacturers as these foci were not powers that were ordinarily carried in stock. Furthermore, it was decided that to take care of the 5% prescriptions which were odd powered combinations and not feasible to carry as a stock item; surface machinery and rough semi-finished cylinders would be added to the present mobile equipment. No bi-focal blanks were included as it was not deemed feasible due to the extra amount of equipment and stock that was needed for such a small percentage of this type of lenses were used. Instructions were issued that were it absolutely necessary to make bi-focals, the Opifex or cemented type should be supplied. With the addition of the surface grinding equipment and rough semi-finished cylinders, combined with the increased foci range, all but a very small percentage of the prescriptions could be filled.

In the meantime, the optical situation in this country had become very acute due to the unforeseen demand. The original total requirements contemplated were for a quarter of a million pair of glasses but by the Spring of 1943, the optical manufacturers in this country were being called upon to supply upwards of 180,000 of spectacles per month, which was beyond their ability due to the shortage of skilled labor and the necessity of retooling at their frame factories so that the

specifications of the Government issue frames could be met. With the frame production capacity of only 150,000 of this type, it was necessary that something drastic be done to eliminate the back log of prescriptions that were rapidly overtaking the manufacturers due to this production bottleneck. Upon analysis it was discovered that over 43% of the prescriptions that were being written were for powers of 1 diopter or under in the meridian of their greatest effect. Further investigation showed that men wearing low powers, or that required 1 diopter or less were receiving their glasses before going overseas, whereas, there were numbers of cases of men completely handicapped without their glasses having to leave without them. It was therefore decided that no spectacles would be issued in which the powers of the strongest meridian was of 1 diopter or less. The Surgeon General's Office realized that this placed a hardship on some men, but it was necessary so that the men handicapped without glasses would be assured of receiving them before leaving for overseas duty. This was done and the acute condition was alleviated.

Early in 1942, on recommendations from the field, the Surgeon General's Office undertook to design a Portable Optical Repair Unit that would fit in one or two standard medical chests and still contain sufficient stock and equipment to service small bodies of troops. It was to be designed so that it could be operated by one skilled optician, having as equipment a hand operated edging stone, cutter, small optical tools and foci range the same as in the Mobile Unit. After being field tested several times the design was adopted.

Also, there was being developed a spectacle frame to be worn under a gas mask. The first type produced was made in the standard 38 and 40 round frames with flat wide temples fitting snugly to the side of the face. This frame when properly fitted was quite satisfactory, but due to the lack of sufficient skilled fitters and because of the possibility of this spectacle getting out of adjustment, the danger from gas leakage was great. It was therefore decided that other means of holding the corrective lens had to be devised. After a great number of exhaustive tests, a gas mask insert that fitted in the eye piece of the gas mask and contained the prescription in a 40 round eye was decided on. This insert could be removed to be cleaned and tests in the field proved its efficiency and while not completely satisfactory, was the one means of being certain that the men needing glasses could be sure of good visual acuity when wearing their gas masks. These inserts eliminated the danger of gas leakage and are now being distributed. Every man who has, without glasses, a visual acuity of 20-70 or worse with both eyes open will receive one pair.

Stocks of these inserts have been sent overseas and the use and directions as to their fitting have been issued to the Optical Unit Commanders and the various Posts and Station Hospitals where eye refracting work is being done. Mobile and Portable Units will be equipped to service these inserts and it is contemplated that lenses for these inserts will be ground to size (40 mm. round) by the manufacturers before being shipped abroad.

There is at present, being designed at Carlisle, Pennsylvania, a new Mobile Optical Repair unit which will have as part of its equipment a single surfacing spindle, laps and tools for surface grinding along with the simplified edging and cutting equipment now on the standard mobile unit. It is contemplated that it will be possible to standardize the equipment on this truck so that repair and replacements of equipment will be simplified and that complete grinding service will be available so that all prescriptions excepting solid or one-piece bi-focals can be filled. This equipment will be installed on a standard Medical Department surgical truck containing running water, heat, light and power. The power for this unit will be supplied by a gasoline motor generator which will be carried in the trailer.

It was the experience overseas that showed the acute need of trained opticians to work in these repair units, therefore in August, 1943, it was decided that an Optical School should be started at the Medical Supply Services School, St. Louis Medical Depot, where men that were opticians in civilian life could be sent and trained in the Army method of making glasses. At the present writing, it has been found that the school can be highly successful in turning out trained men, when supplied with men that have had a reasonable amount of optical experience at bench work during their civilian life.

## THE MOBILE OPTICAL REPAIR UNIT

The purpose of the Mobile Optical Repair Unit is to provide a self-contained edging and mounting laboratory to make emergency repairs and replacements of prescription lenses and spectacles for the American Armed Forces in the field.

The Mobile Unit consists of the necessary marking, cutting, edging and assembling equipment together with properly balanced stocks of lenses, spectacle fronts, temples and spectacle cases designed and arranged to be contained and operated in a 2½ ton U.S. Army truck and a 1 ton trailer.

The Unit is designed to accompany and care for a field Army consisting of 150,000 to 300,000 men and the personnel consists of one officer and six enlisted men. At the present time, the table of organization calls for three optical technicians, two clerks and a driver for the truck. The truck driver also operates a generator which supplies the power for the unit.

The division of the work will be regulated by the experience and ability of the operators who will function under the officer in command. The capacity of the unit should be sixty pairs of lenses (120 single lenses) edged and assembled in an eight hour day and there is also capacity for soldering, straightening and repairing of spectacles.

The stock although subject to variance will approximate 18,000 lenses, 4,500 spectacle fronts and 6,000 pair of temples. The lenses are placed in individual envelopes, wrapped ten to a package and stocked in the steel cabinets provided for the purpose. Mechanical equipment (lensometer, etc.) is included in each unit to determine the foci and axis of spectacles and broken lens.

In the event direct power is not available the unit is supplied by a gasoline electric generator of compact design and light weight as follows: Engine output of not less than 3 K.W., 115 volts, A.C., 1 Ph., 60 cycle: Complete with accessories and spare parts in a carrying chest.

The Mobile Optical Unit operators will make no refractions nor will any unit have the equipment for so doing. The professional ophthalmic services of examining, refracting and prescribing are not a function of the mobile units and must not be constructed as such.

Although the unit is referred to as being mobile, it may upon reaching it's initial destination be set up as a base unit and supplied with additional equipment including spherical surfacing machines, etc. At this time an optical repair laboratory mounted in a surgical truck is being assembled and if proven satisfactory will undoubtedly replace the present unit as an item of standard issue.

## HISTORY OF THE ARMY PROGRAM

### THE PORTABLE OPTICAL REPAIR UNIT

The Portable Optical Repair Unit is designed and equipped to replace and repair spectacles and gas mask inserts in the forward areas of the theatres of operation. The need for a unit of this type was first recognized by a survey based upon Tank Corps personnel during the campaign in Africa, which revealed that the life of a pair of spectacles was one hour.

With the foregoing in mind, the American Army designed a compact unit constructed of light but strong material that could be readily transported. Consequently, the operator can move the unit into close proximity to the troops in the field and render more rapid service than could be obtained from the Mobile Optical Repair Units.

As no organic transportation is provided, it will be necessary for the operator to make arrangements with the Commanding Officer of the organization to which he is attached for the use of a jeep, ambulance or some similar conveyance.

The supplies approximate 1200 pair of lenses, 675 spectacles fronts and 750 pair of temples. At such time as the gas mask insert is made available, a reasonable quantity will be initial issue for the unit. A nominal supply of fit-overs are also stocked, enabling the operator to produce prescription combinations that would otherwise necessitate the use of surfacing equipment.

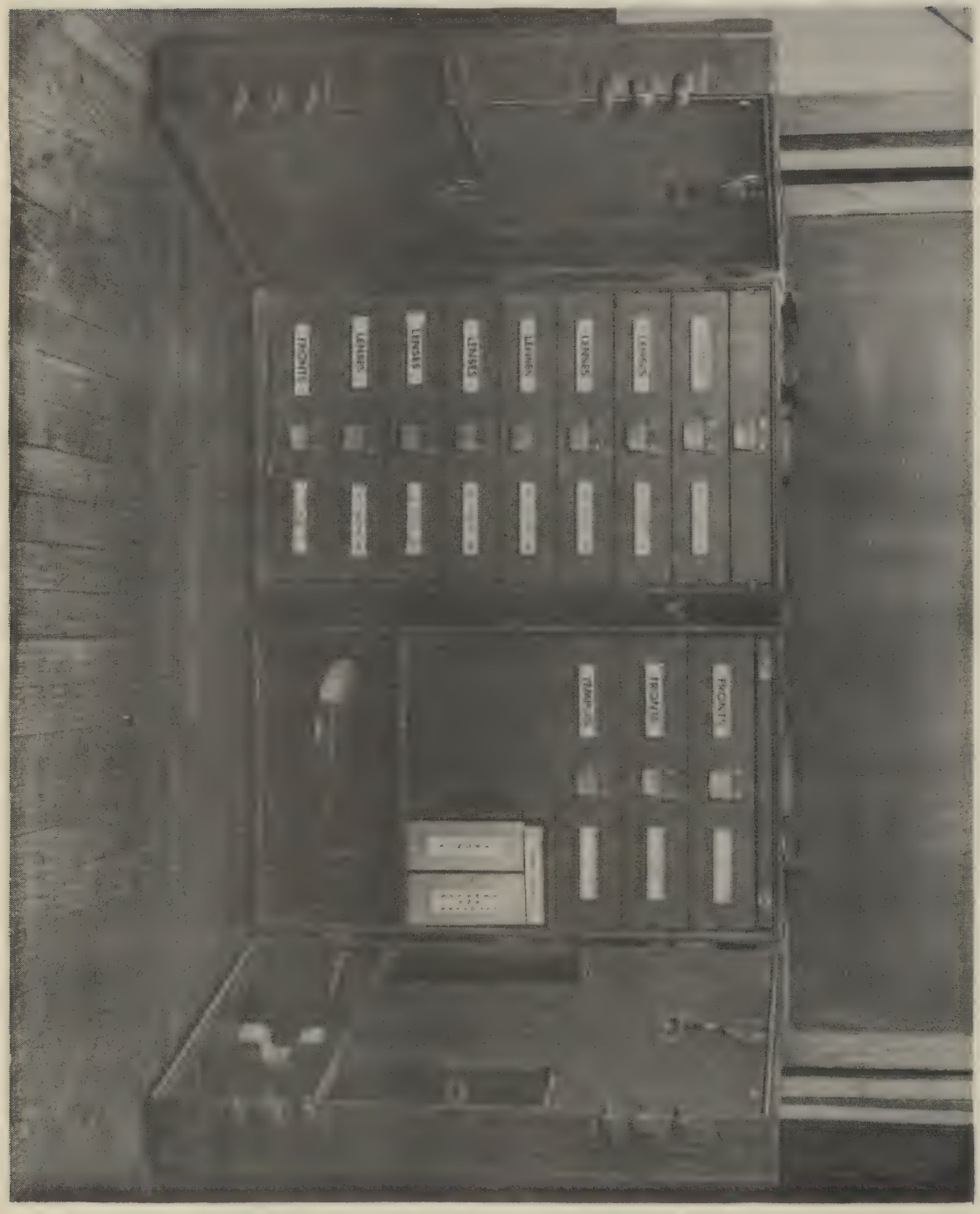
The equipment consists of a hand operated edging unit, lens cutter and the necessary optical tools. Although primarily designed to be operated manually, the edging unit may be driven mechanically when a motor is available. A 1/8th or 1/4th E.P. motor that turns 1800 R.P.M's., may be successfully used by attaching a 1-3/4" pulley to the motor shaft. Assuming that all edging units will have a standard 6" pulley, this ratio will produce the required speed of approximately 500 R.P.M's for the edging wheel.

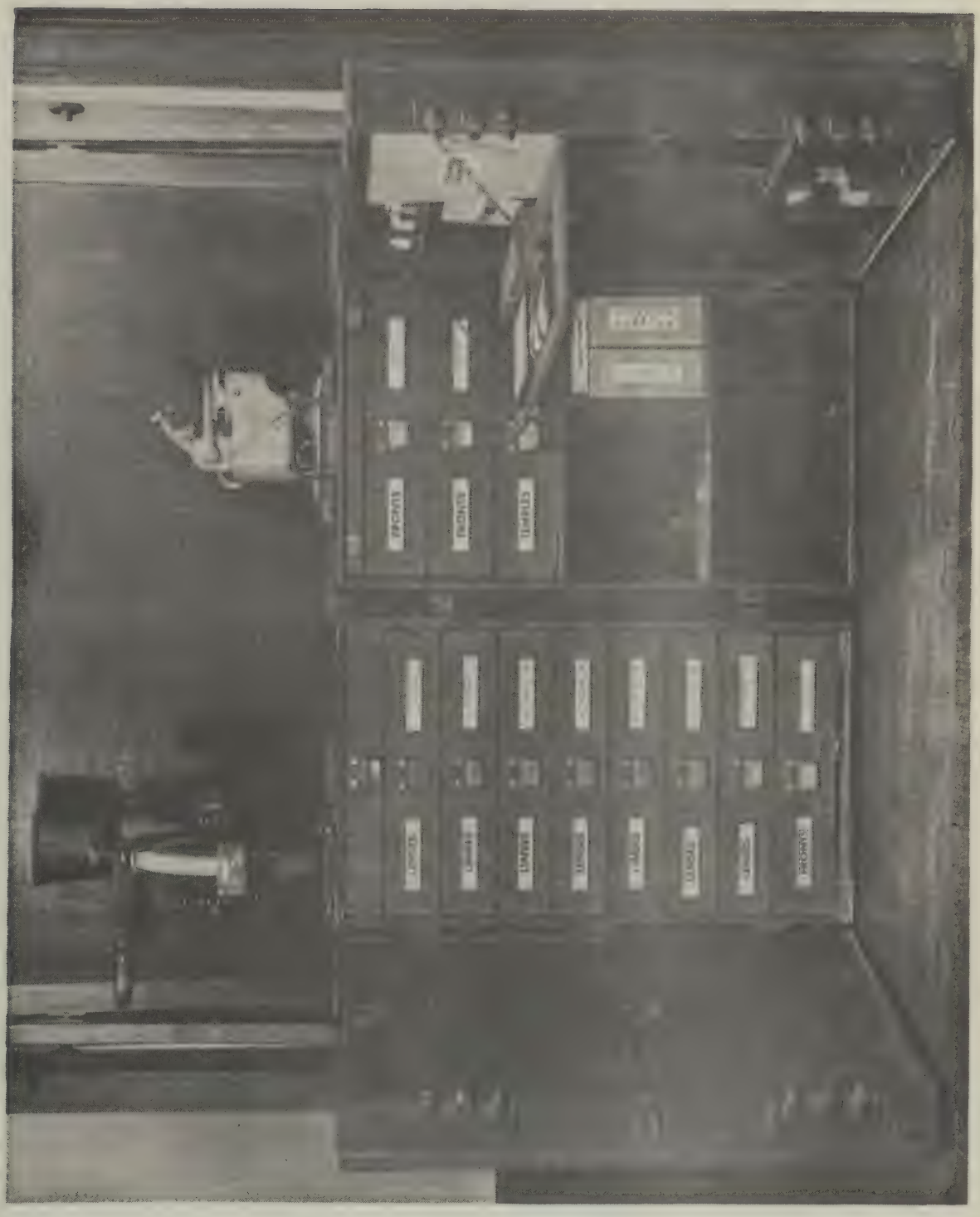
When the edging unit is operated manually the handle will be turned at the ratio of 57 times a minute to produce the required speed.

Inasmuch as the Portable Repair Unit is manned by one operator, it will be essential that he exercise initiative and the ingenuity to improvise under the most adverse conditions in order to maintain the unit in effective operation.

Enlisted men that are chosen to operate Portable Optical Repair Units will have the satisfaction of knowing that only the better optical technicians will be given these assignments.

OPTICAL REPAIR UNIT (PORTABLE)





# SECTION III

# RULES AND POLICIES

# PROCUREMENT OF SPECTACLES FOR MILITARY AND OTHER AUTHORIZED PERSONNEL

## RULES AND POLICIES

## SECTION I

## GENERAL



1. PREVIOUS INSTRUCTIONS RESCINDED - a. This pamphlet supersedes all previous instructions pertaining to the procurement of spectacles, commercial and gas mask type, for military and other authorized personnel, including instructions issued by the Surgeon General in letters, radio, and teletype messages to the commanding generals of the service commands or to the Surgeon General's fiscal branch offices, which are in conflict with this pamphlet.

b. This pamphlet has many material changes in procedure, especially as to the basis of issue of eyeglasses, and therefore the need for careful study cannot be overemphasized, nor the importance of having these instructions brought to the attention of the proper officers of the eye clinics as expeditiously as possible.

2. AUTHORITY - The authority for the procurement and repair of eyeglasses is as follows:

a. For United States Army personnel, including Army nurses, members of the Women's Army Auxiliary Corps, and other militarized female personnel of the Army.

(1) The Surgeon General will provide all military personnel with spectacles, when required, and will replace lenses and frames when either or

both are damaged or lost in the performance of military duty.

(2) The Surgeon General will prepare such instructions as may be necessary and make such contracts and incidental arrangements as may be required. (See par. 10, AR 40-1705, November 2, 1942.)

b. (1) For authorized military personnel of any country the defense of which the President deems vital to the defense of the United States, when such authorized personnel are stationed within the forty-eight States and the District of Columbia and military personnel, wherever location, of all cobelligerent countries who cannot reasonably obtain eyeglasses or replacement and repair thereof from facilities of their own country.

(2) * * * for medical care and treatment of authorized personnel of any country whose defense the President deems vital to the defense of the United States when such care and treatment cannot be obtained from medical units of their own country * * *. See Military Appropriation Act, 1943, and S.G.O. Circular Letter 71, July 17, 1942.

c. For internees (prisoners of war and civilian enemy aliens undergoing internment by the War Department).--Spectacles will be furnished for internees on the same basis as for United States troops. Cost incident thereto are chargeable to funds allocated to The Surgeon General. (See par. 22 for basis of issue.)

d. Repair and replacement of eyeglasses for civilian employees of War Department and Red Cross workers on military missions overseas.--Necessary repair and replacement of spectacles, commercial type, or spectacles, gas mask type, belonging to civilian employees of the War Department and Red Cross workers on military missions overseas will be accomplished by repair and replacement units without cost to the individual. (See also par. 6b (15), AR 40-590, February 2, 1942.)

3. DESIGNATION OF TWO TYPES OF EYEGLASSES - There have heretofore been two types of eyeglasses issued by the Surgeon General, namely, spectacles, commercial type (for ordinary wear), and spectacles, gas mask type (as auxiliary eyeglasses for ordinary wear), the issuance of the latter type being discontinued entirely by provisions of paragraph 19 of this pamphlet. Hereinafter, the terms "spectacles, commercial type" and "spectacles, gas mask type" will be used to designate the specific types of eyeglasses.

4. REFRACTION OF EYES - When refraction of eyes is necessary and a medical officer is not available, request for authority to employ a civilian physician in the case of military and other authorized personnel on detached service or at stations within the continental limits of the United States will be made to the commanding general of the service command concerned, in accordance with paragraph 3d, AR 40-505, September 1, 1942; for personnel on duty in the departments, to the department surgeon; and for personnel on duty in military establishments beyond the continental limits of the United States, to the force surgeon. The request for refraction will be approved in reasonable amount only and will include the adjustment of frames and fitting of spectacles when delivered. Authority for the employment of a civilian physician for refraction will not be granted to military and other authorized personnel who are under orders to report in the near future to a station where Army facilities are available. Authority for the employment of a civilian physician for refraction of eyes will not be granted to military or other authorized personnel absent temporarily for short periods from their proper stations where Army facilities are available.

5. PROCUREMENT AND ISSUE OF EYEGLASSES AT HOME STATIONS - Commanding officers of all posts, camps, and stations will make every effort to procure and issue at home stations as early as possible in the training period, spectacles, commercial type, to military and other authorized personnel requiring eyeglasses, in order to preclude mass requests for ophthalmic examination and procurement of spectacles at personnel replacement depots or staging areas in the event such personnel are ordered to staging areas for transfer to overseas duty. Strict compliance with this paragraph is necessary to avoid military personnel proceeding to oversea stations without the necessary eyeglasses in their possession.

6. ELIMINATION OF 1/8 DIOPTERS IN PRESCRIBING - Effective upon receipt of this pamphlet, medical officers refracting personnel entitled to eyeglasses will not prescribe lenses in 1/8 diopter variations.

7. NEW LENSES FOR CHANGE OF PRESCRIPTION - Authority is granted to procure new lenses by prescription in cases where it is necessary to change the power of the lenses.

8. SHIPMENT AND PACKING - In the event spectacles, commercial type, are received from optical branches, by posts, camps, or stations within the continental limits of the United States to be issued to military or other authorized personnel who have been assigned to oversea duty, the packing of such eyeglasses for shipment to APO addresses will be as follows:

a. Each individual pair of eyeglasses with case will be wrapped in a package or box for shipment, showing on the face thereof the name, serial number, grade, and APO address of the person for whom it is intended.

b. The individual package will then be placed in one large package or box and mailed to the respective APO address. The procedure as outlined will eliminate unnecessary work on the part of the Army post office and all shipments will be handled more expeditiously.

9. SPECTACLE MAILING BOXES - Spectacle mailing boxes are stocked at the St. Louis Medical Supply Depot, St. Louis, Mo., being identified as Item No. 9N071-00, and are to be used as containers for eyeglasses being mailed personnel who have departed from their station prior to receipt of eyeglasses. Requisitions for this item will be forwarded to the Surgeon General, caution being used to requisition such moderate quantities as the demand necessitates. Spectacle mailing boxes will not be purchased from the branch offices of the optical companies under contract.

10. DISPOSITION OF EYEGLASSES WHEN ADDRESS OF INDIVIDUAL IS UNKNOWN - When eyeglasses are received after the individual for whom they are intended has been transferred and every effort has been made without success to determine the correct address to which the eyeglasses should be forwarded, inquires for the correct address may be made of The Adjutant General.

11. CHANGE OF "RECEIPT OF PURCHASE" ON W.D., M.D. FORM NO. 130 (SPECTACLE ORDER FORM) - a. All posts, camps, and stations presently or hereafter holding prescriptions due to hesitancy in signing the receipt of purchase certificate because of lack of information that the eyeglasses have actually been received by the personnel for whom they were intended will alter the aforementioned certificate as authorized in b below, affix signature, and forward the prescriptions for payment.

b. The certificate of the "Receipt of Purchase" on W.D., M.D. Form No. 130 will be changed from--

* * * that they have been delivered to the above mentioned military personnel * * *
to--
* * * and will be delivered to the above mentioned military personnel * * *

c. Certain changes of W.D., M.D. Form No. 130 are being contemplated and the provisions of b above will be included.

12. VOUCHERS AND PRESCRIPTIONS - The subject of vouchers and prescriptions for stations in various localities and for personnel on duty without troops is covered in section IV.

13. CLASSIFICATION OF SPECTACLES, COMMERCIAL AND GAS MASK TYPE, AS INDIVIDUALS' PERSONAL EFFECTS - Spectacles, commercial type, and spectacles, gas mask type, are classified as the individuals' personal effects, and inasmuch as these items are considered expendable supplies, they will not be taken up on the stock record account.

14. INFORMATION NOT TO BE DIVULGED - Information in connection with contracts for the supply and repair of eyeglasses for military and other authorized personnel, especially information in regard to the charges thereunder, will not be divulged to any military personnel, civilian employees of the United States Government, or any other individuals, with the exception of such military personnel and/or civilian employees of the United States Government as require the information for the execution of their duties.

15. AGE AND VISUAL ACUITY OF INDIVIDUAL TYPED ON W.D., M.D. FORM NO. 130 - In preparation of W.D., M.D. Form No. 130 (Spectacle Order Form) for procurement of eyeglasses of any type issued by the Government, the age of the individual concerned will be typed opposite the name, and the visual acuity (without glasses) of the right eye, left eye, and both eyes will be shown in the last column opposite "Dec.In." The letter "R" may be used for right eye; "L" for left eye; and "B" for both eyes. When W.D., M.D. Form No. 130 is revised, space will be provided for these data. These procedures are necessary for statistical purposes and must be complied with.

16. ALL INFORMATION ON W.D., M.D. FORM NO. 130 TO BE TRANSCRIBED TO CARBON COPIES - All information contained on the original of the contractor's bill on W.D., M.D. Form No. 130 (Spectacle Order Form) will be transcribed to the carbon copies, and this will include the invoice number and the branch office identification number of the contractor, as omission of the latter seriously interferes with accounting procedure.

17. DAILY FORWARDING OF FORMS TO OPTICAL COMPANIES UNDER CONTRACT - Posts, camps, and stations procuring spectacles, commercial type will forward requisitions on W.D., M.D. Form No. 130 to the branch office of the optical company concerned for processing at the end of each day and not accumulate such forms for transmittal at various periods. The practice of forwarding forms daily will expedite the delivery of eyeglasses.

18. PERMANENT RECORD OF PRESCRIPTION FOR EYEGLASSES - In order to facilitate the replacement of lost or broken lenses and spectacle frames, a permanent record will be made of pertinent data regarding the prescription for lenses and spectacle frames furnished officers and enlisted men, together with the visual acuity, both with and without lenses, the date and place of refraction, and date and place of issue. In the case of officer, these data will be entered on W.D., M.D. Form No. 81

(Immunization Register), and in the case of enlisted personnel on page 15, W.D., A.G.O. Form No. 24 (Service Record). Effective upon receipt of this pamphlet, a copy of the prescription and frame specification will be given to the individual, and he will be instructed to keep this copy on his person at all times. This is necessary to avoid refraction of eyes each time spectacles are lost or broken. A standard form for this purpose is contemplated. However, in the meantime, eye clinics and station hospitals will use any form they may have adaptable for this purpose.

## SECTION II

## SPECTACLES, COMMERCIAL TYPE, AND SPECTACLES, GAS MASK TYPE



19. USE OF SPECTACLES, COMMERCIAL TYPE, AND SPECTACLES, GAS MASK TYPE - a. Spectacles, commercial type, are to be used for ordinary wear.

b. In recent tests of the spectacles, gas mask type, beneath the gas mask, it was determined that their use in conjunction with the gas mask was impracticable because of the lack of perfect adjustment of the temples, which created discomfort and leakage of gas. In view of the foregoing, all unit commanders will be responsible for directing military and other personnel under their command who are in possession of a pair of spectacles, gas mask type, that such spectacles will not be used beneath the gas mask, but only as an auxiliary pair of spectacles for ordinary wear. In view of the above, Contract No. W 709 and 270, July 1, 1942 is being terminated and the requisitioning of spectacles, gas mask type, is to be discontinued immediately upon receipt of this pamphlet.

c. A substitute eyeglass for use beneath the gas mask is being developed, and when its practicability has been determined instructions on this subject will be issued.

20. PERSONNEL ENTITLED TO EYEGLASSES.

| PERSONNEL | SPECTACLES, COMMERCIAL TYPE |
|---|---|
| a. Officers and enlisted men of the United States Army, including Army nurses, members of the Women's Army Auxiliary Corps, and other militarized female personnel of the Army. | If entitled in accordance with paragraph 21, two pairs of spectacles, commercial type. |
| b. Warrant officers | Do. |
| c. Cadets, United States Military Academy | Do. |

| PERSONNEL | SPECTACLES, COMMERCIAL TYPE |
|---|---|
| d. Aviation cadets, Army Air Forces. . . . . | If entitled in accordance with paragraph 21, two pairs of spectacles, commercial type. |
| e. Contract surgeons (full time of the Army . . . . . | Do. |
| f. Prisoners (United States Army personnel) in military custody . . . . . | Do. |
| g. National Guardsmen in active Federal service . . . . . | Do. |
| h. Reserve officers on extended active duty with the Army . | Do. |
| i. Reserve enlisted men on extended active duty with the Army. . . . . | Do. |
| j. Retired military personnel on active duty with the Army. . . . . | Do. |
| k. Members of the organized military forces of the Government of the Commonwealth of the Phillipines in the service of the armed forces of the United States. | Do. |
| l. Authorized military personnel of any country, the defense of which the President deems vital to the defense of the United States, when such authorized personnel are stationed within the forty-eight States and the District of Columbia, and military personnel, where ever located, of all cobelligerent countries who cannot reasonably obtain eyeglasses or replacement and repair thereof from facilities of their own country . . . . . | Do. |
| m. Such civilian employees of the War Department on military missions overseas as require eyeglasses for the performance of their duties. . . . . | Authorized for repair and replacement only. |
| n. Such Red Cross workers on military missions overseas as require eyeglasses for the performance of their duties. . . . . | Authorized for repair and replacement only. |

| PERSONNEL | SPECTACLES, COMMERCIAL TYPE |
|---|---|
| o. Internees (prisoners or war civilian enemy aliens) undergoing internment by the War Department . . . . . | One pair of spectacles, commercial type, only if entitled in accordance with paragraph 21. |

21. BASIS OF ISSUE - a. Effective upon receipt of this pamphlet the issuance of spectacles, commercial type will be limited to authorized personnel requiring a correction of more than one diopter in the meridian of greatest defect except when in the judgment of the prescribing officer eyeglasses are absolutely necessary due to the age of the individual or to the type of military duty to be performed. Such personnel will be issued two pairs of eyeglasses as promptly as possible after entrance into the service, with the exception of internees (prisoners of war and civilian enemy aliens), who will be issued only one pair provided a correction of more than one diopter is required.

b. The procedure heretofore followed involving the deferred issuance of the second pair of eyeglasses until an individual is under oversea orders is discontinued entirely, and the initial and auxiliary pair of eyeglasses are to be issued simultaneously as early as possible in the training period.

c. For special cases requiring unusually close work for which bifocals are not adapted, the number of pairs of spectacles to be issued will be determined by the prescribing officer.

22. SPECIFICATIONS - Spectacles, commercial type will conform to specifications issued by The Surgeon General, that is, spectacles issued by the American Optical Company or by any other optical company designated or authorized by The Surgeon General. If military or other authorized personnel desire eyeglasses not conforming to the above, such eyeglasses must be purchased by the personnel concerned, and Government funds may not be used for either whole or part payment thereof.

23. TINTED AND ESPECIALLY SHAPED LENSES - The purchase of tinted and especially shaped lenses is not authorized except in connection with repairs as covered by paragraph 24.

24. REPLACEMENT AND REPAIRS; OPTICAL REPAIR AND REPLACEMENT UNITS - a. Before spectacles, commercial type, or spectacles, gas mask type, are replaced or repaired, the responsible officer will assure himself that loss or breakage was in the performance of military or official duty and that no carelessness was involved. Complete replacement will be limited to those individuals entitled to spectacles in accordance with the basis of issue as set forth in paragraph 21. Instances of losses or breakages in excess of three per year will be especially investigated and reported with recommendation to The Surgeon General if in continental United States; to the department or force surgeon concerned in the case of military establishments beyond the continental limits of the United States. On review of the evidence The Surgeon General, the department surgeon, or the force surgeon will determine whether replacement or repair will be made at public expense. Repairs of breakages in the performance of duty will be further governed by the following instructions:

(1) If one lens only is broken, replacement in kind will be made, provided the individual's frame is of durable construction with rims and temples, decision as to durability to rest with the responsible medical officer. If the frame is not durable, new spectacles according to specifications and with untinted lenses will be issued.

(2) If both lenses are broken replacement will be made by untinted lenses per eyeglass specification, these to be placed in the individual's eyeglass frame, provided the frame is of durable construction with rims and temples, decision as to durability to rest with the station surgeon. If the frame is not durable, new spectacles, according to specifications and with untinted lenses, will be issued.

(3) A frame, if broken, will be repaired provided it is of durable construction with rims and temples, decision as to durability to rest with the responsible medical officer. If the frame is not durable, new spectacles according to specifications and with untinted lenses will be furnished.

b. Optical repair and replacement units have been and are being made available in the various theaters of operation, and whenever possible these facilities should be used for the above purposes.

## Section III

## FITTING AND REPAIR CASES



25. FITTING AND REPAIR CASES - The following fitting and repair case is stocked in the St. Louis Medical Supply Depot, St. Louis, Mo., and is issued upon requisition to the Surgeon General: Item 36275, Case, spectacle fitting and repair (for spectacles, commercial type).

26. REQUESTS FOR FITTING AND REPAIR CASES - a. Requests in the form of requisitions by stations within the continental limits of the United States will be made direct to The Surgeon General.

b. Requests in the form of requisitions by stations beyond the continental limits of the United States will be made direct to The Surgeon General through the department or force surgeon concerned.

27. REPLACEMENT OF USED OR DAMAGED ARTICLES IN FITTING AND REPAIR CASES - a. The necessary replacement of used or damaged articles in spectacle fitting and repair cases, such as pliers, tap holders, taps, temples, temple screws, nose pads, end piece screws, etc., should be procured on W.D., M.D. Form No. 130

b. Charges for these purchases will be handled in the same manner as charges incurred for the purchase of eyeglasses.

28. FITTING AND REPAIR CASE FOR EYEGLASSES TO BE WORN BENEATH A GAS MASK - When an eyeglass for use beneath a gas mask is developed, instructions covering the procurement of a fitting and repair case for this type eyeglass will be issued.

## Section IV

## PROCEDURE APPLICABLE TO STATIONS IN VARIOUS LOCALITIES AND TO MILITARY AND OTHER AUTHORIZED PERSONNEL ON DUTY WITH AND WITHOUT TROOPS IN CONTINENTAL UNITED STATES AND IN FOREIGN COUNTRIES



29. STATIONS WITHIN CONTINENTAL LIMITS OF UNITED STATES - For stations within the continental limits of the United States, the following will apply:

a. Orders for eyeglasses will be placed by a medical officer as heretofore on W.D., M.D. Form No. 130.

b. Upon receipt of spectacles from the contractor, together with the original of Form No. 130, the receipt of purchase should be executed by a commissioned or warrant officer and forwarded, together with three copies executed as provided in paragraph 16 direct to the appropriate fiscal branch office.

30. MILITARY AND OTHER AUTHORIZED PERSONNEL WITHOUT TROOPS IN CONTINENTAL UNITED STATES - If refraction is necessary and no medical officer is available, request for authority to employ a civilian physician will be made to the commanding general of the service command concerned in accordance with paragraph 3d, AR 40-505, September 1, 1942. See paragraph 4.

31. ALASKA; HAWAII; PANAMA, PUERTO RICAN, AND TRINIDAD SECTORS OF CARIBBEAN DEFENSE COMMAND; NEWFOUNDLAND; GREENLAND AND ICELAND - Military and other authorized personnel stationed at such places as mentioned will be governed in the issuance of spectacles, commercial type, by the provision of paragraph 21.

32. MILITARY AND OTHER AUTHORIZED PERSONNEL ON DUTY WITHOUT TROOPS IN FOREIGN COUNTRIES - For such personnel, the following instructions will apply:

a. Prior authority for the refraction of eyes will not be required. Accounts for such services at reasonable rates will be paid locally.

b. Spectacles, commercial type - Authority is granted for local procurement at reasonable rates, frames to be of durable construction with rims and temples, payment

for which will be made locally. However, the above applies only if personnel are entitled thereto as provided by paragraph 21.

(A.G. 413.75 (4-3-43).)

By order of The Secretary of War:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:
J. A. ULIO,
Major General,
The Adjutant General.

A TRUE COPY

S. E. LaRose
2nd Lt. Med. Adm. C.

(W40-18-43)

WAR DEPARTMENT
The Adjutant General's Office
Washington 25, D.C.

MEMORANDUM )
NO. W40-18-43) 28 July 1943.

BASIS OF ISSUE OF SPECTACLES

1. Reference is made to paragraph 21, Pamphlet No. 8-5, War Department, 1943, wherein a basis of issue of spectacles is set forth, limiting the issuance of spectacles to authorized personnel requiring a correction of more than one diopter in the meridian of greatest defect except when in the judgment of the prescribing officer eyeglasses are absolutely necessary because of the age of the individual or the type of military duty to be performed.

2. A recent analysis of prescriptions indicates that during the months of May and June a disproportionate portion were for lenses of one diopter or less, resulting in an over-all total of prescriptions considerably beyond the capacity of existing facilities to complete without serious delays. It is apparent that the discretionary factor has been used rather liberally, and the sharply increased requirements for spectacles have resulted in a serious shortage of frames and lenses. Additional productive facilities have been called upon to meet increased requirements, but these increased supplies cannot be made immediately available.

3. In view of the above, and in order that personnel who absolutely require eyeglasses (those requiring a correction of more than one diopter in the meridian of greatest defect) may receive them without undue delay, the following basis of issue is effective immediately, superseding the basis of issue set forth in paragraph 21, Pamphlet No. 8-5, until sufficient frame and lens stocks are available:

> The issuance of spectacles, commercial type, will be limited to authorized personnel requiring a correction of more than one diopter in the meridian of greatest defect. Such personnel will be issued two pair of eyeglasses as promptly as possible after entrance into the service, with the exception of internees (prisoners of war and civilian enemy aliens), who will be issued only one pair provided a correction of more than one diopter is required. Personnel requiring a correction of one diopter or less in the meridian of greatest defect *will not be issued eyeglasses at Government expense.*

4. With reference to paragraph 18, Pamphlet No. 8-5, prescribing officers are charged with the responsibility of determining before spectacles are requisitioned whether the respective personnel have previously been furnished with spectacles at Government expense, and if so, whether the provisions of paragraph 24, Pamphlet No. 8-5, are being complied with. This responsibility may properly be discharged by requiring the information in writing from respective unit commanders.

(W40-18-43)

(AG 413.75 (23 Jul 43)SPMCJ-MB-E)

By order of the Secretary of War:

/s/ J.A. Ulio
J.A. ULIO,
Major General,
The Adjutant General.

DISTRIBUTION:
A.

A TRUE COPY

S.E. LaRose
2nd Lt. Med. Adm. C.

(W40-18-43, C 1)

WAR DEPARTMENT
The Adjutant General's Office
Washington 25, D.C.

MEMORANDUM )
No. W40-18-43)
Changes No. 1)

10 September 1943.

## BASIS OF ISSUE OF SPECTACLES

Paragraph 3, Memorandum No. W40-18-43, this office, 28 July 1943, subject as above, is amended by redesignating the present paragraph 3a and adding b as follows:

b. This basis of issue is not applicable to military personnel assigned to the Army Air Forces. However, prescriptions for such individuals calling for single vision lenses of one diopter or less in the meridian of greatest defect will be accomplished by a Certificate of Necessity, the original of which will be signed in autograph by the prescribing officer, setting forth in brief detail the particular circumstances which necessitate the furnishing of the correction. Such prescriptions not accompanied by this certificate will not be filled by the optical companies under contract with the War Department. The Certificate of Necessity will be in the following form:

CERTIFICATE OF NECESSITY

_____
(Date)

_____
(Grade) (First name, middle initial, last name) (Serial No.)

is a member of the Army Air Forces, and it is necessary that this individual be furnished spectacles requiring a correction of one diopter or less in the meridian of greatest defect at government expense for the following reasons _____

_____

_____

_____

_____

The visual acuity of this individual without glasses is R_____ L _____
and with both eyes open _____

_____
(Name and grade)

(W40-18 43, C 1)

(1) This certificate will be made out in an original and five copies as follows:

(a) The original and one copy to be securely attached to the original of W.D., M.D. Form No. 130 (the copy of the certificate to be forwarded by the Fiscal Branch Office to the Office of The Surgeon General, Washington, D. C., for analysis and review).

(b) Three carbon copies of the certificate to be attached to three copies of Form No. 130.

(c) The remaining copy to be attached to the copy of the prescription which is given to the individual in accordance with paragraph 18, War Department Pamphlet No. 8-5.

(2) The service point of the optical company will retain one copy of the Form No. 130 with the certificate attached as prescribed above for their files. When the Forms No. 130 are forwarded to the Fiscal Branch Office for processing for payment, it is important that the original and one copy of the certificate be attached securely to the original of Form No. 130 and the two remaining copies of the certificate attached to two copies of the Spectacle Order Form.

(3) With respect to the foregoing, it is emphasized that corrections of one diopter or less in the meridian of greatest defect are to be held to a strict minimum and are to be prescribed only in cases when absolutely necessary for the performance of military duties.

(AG 413-75 (30 Aug 43) OB-P-SPMDA-MB-A)

By order of the Secretary of War:

/s/ J.A. Ulio,
J.A. ULIO,
Major General,
The Adjutant General.

DISTRIBUTION:
A.

A TRUE COPY

S. E. LaRose
2nd Lt. Med. Adm. C.

## PROCEDURE FOR THE OPERATION OF THE MOBILE, BASE AND PORTABLE OPTICAL REPAIR UNITS

GENERAL - The mobile, base and portable optical repair units were designed for the purpose of repair and maintenance of government issue, white metal, rimmed spectacles with first quality, white lenses. These optical repair units were not intended to repair, replace or fill prescriptions for bifocal lenses, colored lenses, rimless spectacles, lenses in 1/8 diopter variations or frames other than the government issue, white metal, rimmed spectacle. For that reason, the optical repair units will not be furnished with supplies for maintenance of the items enumerated above.

### BASIS OF ISSUE AS SET FORTH IN WAR DEPARTMENT PAMPHLET NO. 8-5, 30 APRIL 1943 AND WAR DEPARTMENT MEMORANDUM NO. W40-18-43, 28 JULY 1943

The Optical Advisory Board of The Surgeon General's Office has determined that government issue spectacles would not be given to personnel requiring a correction of one diopter or less in the meridian of greatest defect except in unusual cases where eyeglasses are absolutely necessary due to the age of the individual or to the type of military duty to be performed. The issuance of glasses to such individuals, however, must be authorized by the prescribing medical officer, and it will be his responsibility to maintain at a minimum such issuances of glasses.

Personnel entitled to the initial issuance and repair of spectacles by the optical repair units are as follows:

a. Officers and enlisted men of the United States Army, including Army nurses, members of the Women's Army Corps, and other militarized female personnel of the Army.

b. Warrant Officers.

c. Cadets, United States Military Academy.

d. Aviation cadets, Army Air Forces.

e. Contract surgeons (full time) of the Army.

f. Prisoners (United States Army Personnel) in military custody.

g. National Guardsmen in active Federal service.

h. Reserve officers on extended active duty with the Army.

i. Reserve enlisted men on extended active duty with the Army.

j. Retired military personnel on active duty with the Army.

k. Members of the organized military forces of the Government of the Commonwealth of the Phillipines in the service of the armed forces of the United States.

l. Authorized military personnel of any country, the defense of which the President deems vital to the defense of the United States, when such authorized personnel are stationed within the forty-eight States and the District of Columbia, and military personnel, wherever located, of all cobelligerent countries who cannot reasonably obtain eyeglasses or replacement and repair thereof from facilities of their own country.

m. Such civilian employees of the War Department on military missions overseas as require eyeglasses for the performance of their duties.

n. Such Red Cross workers on military missions overseas as require eyeglasses for the performance of their duties.

o. Internees (prisoners of war and civilian enemy aliens) undergoing internment by the War Department.

FRAMES - Government issue spectacles are composed of a white metal, rimmed, spectacle frame and the supplies of frames furnished to the optical repair units will be only of the standard type. Supplies will not be furnished for the repair of rimless spectacles, and for that reason, any breakage of a rimless spectacle should be replaced by one of the standardized type. Breakage of temples and fronts of other serviceable, rimmed, metal frames (not of government issue) will be replaced with either a new standard temple or front, or complete frame.

LENSES - The stock of lenses issued for distribution as replacement stock of the optical repair units is deemed of sufficiently wide range to insure filling of approximately 95% of all prescriptions. Although prescriptions of one diopter and less in the meridian of greatest defect are not to be filled except when authorized by a medical officer, a moderate supply of low powers is being furnished to take care of cases where one lens is one diopter or less but the other is above one diopter. Lenses of 1/8 diopter variations are not supplied inasmuch as the Optical Advisory Board in The Surgeon General's Office determined that prescriptions in 1/4 diopter variations would provide adequate and satisfactory corrections and reduce the quantity of stock lenses necessary. Furthermore, the Optical Advisory Board of The Surgeon General's Office has agreed that stock foci should be substituted when filling a prescription for a foci not carried in stock providing the substitution does not amount to more than a 1/4 of a diopter in either the spherical or cylindrical powers. For example, a prescription calling for a -7.00 +2.25 may be filled by a -7.00 +2.00 which will be carried in stock; +5.25 +2.00 - substitute +5.00 +2.00; -8.00 +.25 - substitute -8.00 sphere.

Recently, requisitions have been received for a foci and types of lenses and ophthalmic materials which are not carried in stock, and such requisitions cannot be filled by this office without serious delays. Evidence shows that commanding officers of the optical units do not decenter lenses to achieve prismatic effect in high powers where it is possible to decenter and thereby effect such desired prism. Also, vertex distance is not to be considered in high powered lenses, and such effects should be considered whenever feasible to eliminate the need of surface grinding.

Surfacing equipment is being furnished each mobile and base optical unit for grinding spherical surfaces, and it is believed that with the stock of rough blanks and semi-finished lenses furnished and the surfacing equipment, all the prescriptions received by these units can be properly filled. A cylinder surfacing machine was not furnished inasmuch as the equipment, machinery and stock of rough blanks necessary to do this work would be impracticable in view of the limited need for such equipment and because of the fact that the spherical surfacing equipment could achieve substantially the same results by using the semi-finished lenses supplied. Replacement stocks of semi-finished cylinders from plus .50 to plus 8.00 will be furnished upon requisition.

In view of the limited number of requisitions originating for bifocal lenses, it is the policy of The Surgeon General's Office that one piece or fused bifocals will not be serviced by the Optical Repair Units.

In substitution for a bifocal prescription, two pairs of glasses, one reading and one distance, will be supplied, or in very exceptional cases where bifocals must be supplied or repaired, the surfacing equipment will be used to make opifex or cemented type bifocals. For such cases, a supply of Canada balsam is included.

In no instance will repairs of spectacles or replacement of lenses include the duplicating of the other lens or the initial supply, if such lenses are colored. The many different types and shades of colored lenses makes it wholly unfeasible to furnish such supplies to Optical Repair Units. Furthermore, no provision for the issuance of such colored lenses has been made.

REQUISITIONING OF FRAMES AND LENSES - Previously, The Surgeon General's Office advised the various mobile and base units that an automatic supply of frames and lenses to cover estimated requirements for three month periods would be established. However, this automatic flow program has been disapproved and under the existing policy, requisitions must be originated in the various theaters in the usual manner for these ophthalmic supplies. Inasmuch as a procurement program has been set up for frames and lenses to cover oversea requirements, it is necessary in the requisitioning of such ophthalmic supplies that frame sizes and lens foci be requisitioned only in such powers as have been placed in procurement and stocked. Requisitions should be placed for ophthalmic supplies covering a three month period in order that procurement programs may be kept in line with the stocks furnished, and it is essential that requisitions be made on this basis. Each requisition shall have attached a brief summary of the number of jobs done each month for the previous three months, the figures to show separately the total number of repair and the total number of complete replacement jobs. Overstocking of ophthalmic supplies on the part of mobile and base units can seriously interfere with the stock control, and may prove to be a serious handicap in the event the unit is moved from one territory to another.

In order that realistic needs can be requisitioned, some practicable form of stock control is recommended in order that more or less accurate requirements can be listed. This is necessary in view of the fact that productive facilities in this country are being heavily taxed, and accurate planning of the procurement program must be effected in order that requisitions placed by the mobile and base optical repair units may be filled promptly. With stockpile quantities of expendable ophthalmic supplies available for oversea maintenance, there is no need for requisitioning supplies in excess of actual requirements, and adherence to the recommended procedures will minimize delays and procurement difficulties.

Attached hereto is a chart of the frames and lenses presently available in stock for which a procurement program has been initiated. Again, it is emphasized that the requisitioning of ophthalmic supplies should be within this range of frames and foci of lenses.

Also attached hereto is list showing the various stocks placed in procurement of surfacing supplies and the range of rough blanks and semi-finished meniscus.

SUMMARY - It is anticipated that the officers in charge of optical repair units will recognize the problems involved in the procurement and distribution of ophthalmic supplies in overseas theaters, and that they will cooperate to the fullest extent in the program described herein. Any reasonable and constructive suggestions for improvement of the program will receive every consideration, and this office

urges the officers in charge of optical units to submit frequent report of their problems. These should be submitted through channels to the Office of The Surgeon General and the practice of some officers whereby their needs and criticisms are directed to acquaintances in the service or former associates in the optical industry or profession is to be discouraged.

A TRUE COPY

S. E. LaRose
2nd Lt. Med. Adm. C.

MILITARY RECORDS

SERVICE RECORD

CHANGES )
NO. 22 )

WAR DEPARTMENT
Washington 25, D. C., 22 January 1944

AR 345-125, 1 February 1932, is changed as follows:

4. Other data required - a. Such other data required by the printed headings on W.D., A.G.O. Form No. 24, not mentioned in these regulations, will be entered from time to time as occasion arises, care being taken to make the records complete and up to date at all times, except that no entry will be made on page 2 under "Occupational Qualifications" at induction stations and no entries will be made at reception centers in case of routine processing under "appointment, promotion, or reduction with authority therefor", nor under "Organization to which attached" on page 5. A service record coming into the custody of any officer will be carefully scrutinized, and if any entry on the form appears incomplete, steps will be taken to secure the necessary data and complete the entry.

b. Eyeglass, gas mask, M-1 (spectacles.)

(1) A spectacle for use beneath the gas mask, which becomes an integral part of the mask to which it is fitted, is available for issue in the zone of the interior to those individuals entitled to the eyeglass; the eyeglass, gas mask, M-1, and size of the proper fitting mask, will be entered on page 15 under "Remarks-Administrative," as the space on page 2, of the service record, "size of gas mask" is not sufficient to enter the above information.

(2) All conflicting instructions regarding the entry in the service record of the eyeglass, gas mask, M-1, are rescinded.

(A.G. 201.3 (17 Nov 43)) (C 22, 22 Jan 44.)

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL
Chief of Staff

OFFICIAL
J. A. ULIO
Major General,
The Adjutant General

DISTRIBUTION:
A: E.

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S. E. LaRose
2nd Lt., Med. Adm. C.

*These changes supersede C 15, 7 June 1943

CIRCULAR )
NO. 55 )

WAR DEPARTMENT,
WASHINGTON 25, D.C., 7 February 1944

IV--SPECTACLES.--1. Memorandum No. W40-18-43, 28 July 1943, subject Basis of Issue of Spectacles, including C 1, 10 September 1943, and paragraphs 18 and 21, Pamphlet No. 8-5, War Department, 1943, are rescinded.

2. Effective immediately, the professional basis of issue of spectacles, commercial type, to authorized personnel will be as follows:

a. To individuals having a visual acuity of worse than 20/100 in either eye.

b. To other individuals who, in the opinion of the prescribing officer, require spectacles for the efficient performance of military duties, regardless of their visual acuity.

c. Personnel entitled to spectacles will be issued two pairs of spectacles with the following exceptions:

(1) Prisoners of war and civilian enemy aliens will be issued only one pair each.

(2) Special cases requiring unusually close work for which bifocals are not adapted will be issued the number of pair of spectacles as determined by the prescribing officer.

3. Examination for spectacles will be made as early as possible during the basic training period. This examination will include those individuals having a visual acuity of worse than 20/40 in either eye and 20/100 or better in each eye. The purpose of such examination will be to avoid borderline cases reaching staging areas or ports of embarkation without complete examination having been made.

4. a. Prescribing officers are urged to exercise the discretionary basis of issue (par. 2b) with careful judgment in order that spectacles will be furnished only when they are necessary for the official performance of military duties.

b. When a prescription for spectacles is issued for an individual having a visual acuity of 20/100 or better in each eye, the prescription will be accompanied by a certificate of necessity, the original of which will be signed in autograph by the prescribing officer setting forth in brief but complete detail the reason for furnishing such correction. The optical companies under contract with the War Department are not authorized to fill such prescriptions unless accompanied by the certificate of necessity.

c. The certificate of necessity will be in the following form:

CERTIFICATE OF NECESSITY

_____
(Station)

_____
(Date)

The visual acuity of _____
(Grade) (Serial No.) (First name, middle initial, last)
without glass is R_____, L_____, and with both eyes open_____, and it is necessary that this individual be furnished spectacles at Government expense for the following reasons:_____

_____

_____

_____

_____
(Name and grade)

(1) This certificate will be made out in an original and five copies as follows:

(a) The original and one copy to be securely attached to the original of W.D., M.D. Form No. 130 (Spectacles Order), the copy of the certificate to be forwarded by the Fiscal Branch Office of the Office of The Surgeon General, Washington 25, D. C., for analysis and review.

(b) Three carbon copies of the certificate to be attached to three copies of Form No. 130.

(c) The remaining copy to be attached to the copy of the prescription which is given to the individual. See paragraph 5c.

(2) The service point of the optical company will retain one copy of the Form No. 130 with the certificate of necessity attached for their files. When the Forms No. 130 are forwarded to the Fiscal Branch Office for processing for payment, it is important that the original and one copy of the certificate be attached securely to the original of Form No. 130 and the two remaining copies of the certificate of necessity attached to two copies of the Form No. 130.

5. In order to facilitate the replacement of lost or broken lenses and spectacle frames, a permanent record will be made. In the case of officers, these data will be entered on W. D., M.D. Form No. 81 (Immunization Register), and in the case of enlisted personnel, on page 15, W. D., A. G. O. Form No. 24 (Service Record). The following data will be made a part of such records:

a. When in the opinion of the prescribing officer, spectacles are not required, entry will be made showing date of examination and stating that spectacles are not required for the efficient performance of military duties.

b. If, after examination it is found that spectacles are required, the following entries will be made.

(1) Prescription data.

(a) Date of refraction.
(b) Place of refraction.
(c) Correction required for each eye.
(d) Size frames and lenses.
(e) Visual acuity each eye, with and without correction.
(f) Visual acuity (binocular) with and without correction.

(2) Issue data.

(a) Date spectacles ordered.
(b) Date of issue of spectacles.
(c) Number pairs spectacles issued to the individual.

c. A copy of the prescription and frame specifications will be given to the individual and he will be instructed to keep this copy on his person at all times. This is necessary to avoid refraction of eyes each time spectacles are lost or broken. Eye clinics and station hospitals will use any prescription form they have adaptable for this purpose.

6. Prescribing officers are responsible for determining whether the individual has previously been furnished spectacles at Government expense before spectacles are ordered. This responsibility can be properly discharged by requiring this information in writing from the individual's commanding officer. See paragraph 5 and paragraph 24, Pamphlet No. 8-5, War Department, 1943.

7. Commanding officers of posts, camps, and stations are responsible for establishing proper local procedures for the issuance of spectacles.

(A.G. 413.75 (31 Jan 44))

BY ORDERS OF THE SECRETARY OF WAR:

G. C. MARSHALL
Chief of Staff

OFFICIAL:
J. A. ULIO,
Major General,
The Adjutant General

A TRUE COPY

S. E. LaROSE
2nd Lt., Med. Adm. C.

# SECTION IV

# PRESCRIPTION

# PRESCRIPTIONS

The prescription form in current use is War Department, Medical Department, Form #130. This form is undergoing revision but until such time as the revised form becomes an issue, it will be used by field optical repair units although portions of the form are only applicable to spectacles processed by civilian firms under government contract.

When a prescription accompanies spectacles sent to a field unit for repair or replacement it is advisable to neutralize the lenses to determine if they are in agreement with the prescription. If they are not in agreement and the prescription does not indicate a recent refraction, the optical officer should be contacted and advised as to the discrepancy. The optical officer will contact the source of origin of the prescription if practicable or make a notation on the prescription as to which lenses were supplied and the reason for so doing.

Spectacles received without a prescription will be accurately duplicated. Frequently only a fragment of a plano or sphero cylinder lens will be presented for replacement and it will test the operators skill to determine the correct meridian of the axis. The duplicating of lenses for a government issue frame will not be as difficult as a similiar duplication for a gas mask insert due to the difference in the shape of the lenses. It is therefore mandatory that the $180^{\circ}$ line of each round lens be accurately marked. The two most satisfactory methods of so marking a lens are by a diamond mark on the lens or a file mark on the bevel of the lens. Either of these methods will in no way impair the vision nor weaken the lens and will serve as a guide for subsequent lens replacements.

The original prescription will be returned with the processed spectacles. It is advisable to maintain a record book in which each prescription is entered and given a number as it will be of assistance in the proper control of the unit stock. It has been found inadvisable to use the original prescription as a work order as it might lose its legibility due to saturation by water, rough or emery.

Extreme care must be exercised in transferring the original prescription to a work order. The changing of a plus or minus sign or a decimal point will cause the selection of an improper lens and will necessitate the reprocessing of the lenses.

If time permits, the practice of checking lens foci in the lensometer is advisable. Occasionally lenses are placed in the wrong envelope and this fact should be determined before, rather than after the glasses have been completed.

The work copy of the prescription will then be placed in a tray and the proper lenses, fronts, temples, etc., will be selected from stock. These items will be deducted on the stock record cards. (Some unit commanders may not maintain such cards as the method of stock control is optional.) There is, of course, no accountability for mobile unit stock but there is the usual responsibility and the unit commander will establish some form of stock control. The maintaining of a stock record account similiar to that kept by an accountable office is recommended.

Substitution of lenses must be approved by the unit or installation optical officer unless such authority has been delegated to a member of the unit personnel. In the selection of spectacle fronts, one with sufficient stock in the bridge for proper bending will be selected from stock when the size indicated on the prescrition is depleted. Temples may be cut to the desired length and a drop of solder placed on the end to prevent the cable from ravelling. If pressed for time the temple may merely be turned back to the desired length. Temples (gas mask type) if available, may be substituted for regular temples.

The work order accompanied by the properly selected items will then proceed through the regular work channels. (Marking, cutting, edging, assembling and inspection.)

A record of breakage must be maintained in order that proper deductions from the stock records may be made. This record is also of value in determining the efficiency of the technical personnel. Although every effort will be made to eliminate breakage, a reasonable amount of stock loss is expected from this source. The use of breakage slips, which must be presented to obtain replacement material, has been found effective.

The final inspection of the completed spectacles should be made from the original prescription rather than the work order. It is obvious that by so doing, errors that occurred during the transferring of the prescription to the work order will be determined.

For the guidance of the personnel of field optical repair units, the following is quoted:

Paragraph 6, War Department Pamphlet No. 8-5.

"Elimination of 1/8 diopters in prescribing.--Effective upon receipt of this pamphlet, medical officers refracting personnel entitled to eyeglasses will not prescribe lenses in 1/8 diopter variations."

Paragraphs 1, 2, and 3, Memorandum (W40-18-40) the Office of the Adjutant General, 28 July 1943.

"1. Reference is made to paragraph 21, Pamphlet No. 8-5, War Department, 1943, wherein a basis of issue of spectacles is set forth limiting the issuance of spectacles to authorized personnel requiring a correction of more than one diopter in the meridian of greatest defect except when in the judgment of the prescribing officer eyeglasses are absolutely necessary because of the age of the individual or the type of military duty to be performed.

2. A recent analysis of prescriptions indicates that during the month of May and June a disproportionate portion were for lenses of one diopter or less, resulting in an over-all total of prescriptions considerably beyond the capacity of existing facilities to complete without serious delays. It is apparent that the discretionary factor has been used rather liberally, and the sharply increased requirements for spectacles have resulted in a serious shortage of frames and lenses. Additional productive facilities have been called upon to meet increased requirements, but these increased supplies cannot be made immediately available.

3. In view of the above, and in order that personnel who absolutely require eyeglasses (those requiring a correction of more than one diopter in the meridian of greatest defect) may receive them without undue delay, the following basis of issue is effective immediately, superseding the basis of issue set forth in paragraph 21, Pamphlet No. 8-5, until sufficient frame and lens stocks are available:

> The issuance of spectacles, commercial type, will be limited to authorized personnel requiring a correction of more than one diopter in the meridian of greatest defect. Such personnel will be issued two pair of eyeglasses as promptly as possible after entrance into the service, with the exception of internees (prisoners of war and civilian enemy aliens), who will be issued only one pair provided a correction of more than one diopter is required. Personnel requiring a correction of one diopter or less in the meridian of greatest defect will not be issued eyeglasses at Government expense."

## PRESCRIPTIONS

If any doubt exists as to the contents of an optical prescription it should be referred to the optical officer for decision.

The efficiency of a field optical repair unit will be judged by the quantity and quality of the work it produces. The careful copying, transposing or interpretation of a prescription would be a factor in acquiring the efficiency required of Army Optical repair Units in the field.

# SECTION V

# FOCAL POWER OF OPHTHALMIC LENSES

# FOCAL POWER OF OPHTHALMIC LENSES

The lens, as understood in the prescription shop, is a piece of glass bounded on the front and back by polished surfaces and surrounded in all other directions by an edge. The surfaces may be flat, spherical, cylindrical, toric or aspheric, as the conditions require.

The lens is supported in position before the eye by a piece of apparatus known as a frame. The frame in turn is supported by some one or more of the facial features.

The lens as worn before the eye serves one or both of two purposes. It may be worn (1) for the protection of the eyes, (2) as a help to vision. This course is concerned only with the latter.

The polished surfaces of the lens are its refracting equipment - are, in fact, what makes the lens useful as a lens. The lens has two general classifications:

1. Convex or plus (+) lenses
2. Concave or minus (–) lenses
   (See Diagram MSSS I - 0-104)

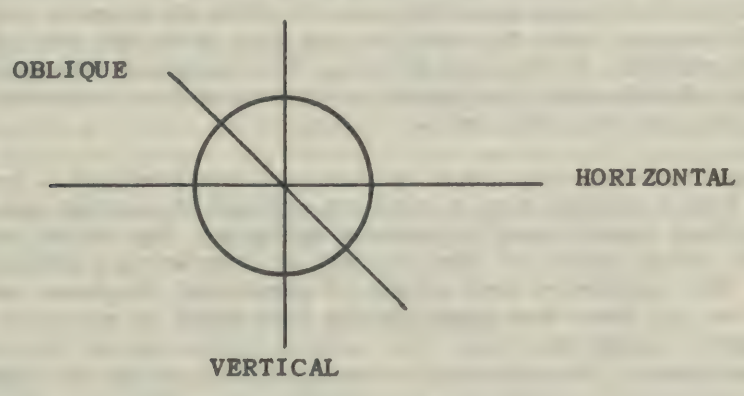
The unit of measurement used to express the power or focus of a lens is a diopter. A 1.00 diopter lens has a focal length of one meter or 39.37 inches. To find the equivalent of diopters in inches, divide 39.37 by the number of diopters. To find the equivalent of inches in diopters, divide 39.37 by the focal length in inches. The focal length in millimeters is found by dividing 1,000 by the number of diopters. MSSS Chart A-104 gives the accurate equivalents for the common powers.

The focus is the point where all lines converge or meet.

As the power of a lens increases, the focal length becomes shorter.

Light rays always bend toward the thicker portion of the lens.

Spherical or Meniscus lenses have the same power in all directions.




There are four general types of spherical lenses:

PLUS LENSES

1. Double convex (DCX)
2. Plano convex (PL-CX)
3. Periscopic convex (PCX)
4. Meniscus convex (MEN or MCX)

## FOCAL POWER OF OPHTHALMIC LENSES

### MINUS LENSES

1. Double concave (DCC)
2. Plano concave (PL-CC)
3. Persicopic concave (PCC)
4. Meniscus concave (MCC)

(See Diagram MSSS I - 104)

The base curve of a lens is that curve from which all others are computed.

For example: If you required a +2.00 D lens which has a base curve of -6.00 D, it would be necessary to grind a +8.00 D curve on the plus side to obtain the desired power. A base curve of -1.25 D would require an outside curve of +3.25 D. A +1.00 D base curve would require the grinding of a +1.00 D curve on the opposite side, etc.

A cylinder lens is by definition a lens, one of whose surfaces is a portion of a cylindrical surface. Bearing in mind that curvature controls the power of a lens, it can be visualized that each meridian of a cylinder lens has a different power. However, we are only concerned with the principal meridians, of which there would be two, the meridian with the least power and the meridian with the greatest power.

For example: The two principal meridians of a +2.00 D Plano-cylinder would be Plano in the lesser meridian and +2.00 in the greatest meridian.

The cylinder lens can be combined with a sphere producing a sphero-cylinder or compound lens. A +2.00 D Sphere combined with +2.00 D cylinder would produce the following principal meridians:

+2.00 in the lesser and +4.00 in the greater. The lesser meridian giving the spherical power and the greater giving the combined power of the sphere and cylinder. The difference between the lesser meridian and the greater meridian would be the cylindrical power of the lens.

The power of a lens and the focal length of a lens convey the same information; one is the reciprocal of the other. Either one of these terms describes how much the lens converges or diverges parallel rays of light which enter the lens parallel to the axis. Either one fixes the point on the axis where the rays of light come to a focus, real or virtual, as the case may be. Now to define this point we must have some fixed point of reference from which to measure and it is evidently some point common to the lens and the optic axis.

It is commonly understood, when we say that the power of a lens is +1.00 D, that the light from a distant source comes to a focus at a point one meter from the lens. This is often a sufficiently accurate statement, for we may not care to know the power within close limits of error or may be discussing a theoretical lens infinitely thin. But suppose we have a lens of commercial thickness and wish to know the power accurately. From what point of the lens shall we measure, from a surface or from some point inside the lens? For some purposes we use the rear surface as the point of reference. The distance to the focus is called the "back focus". In some cases, we use a point inside the lens which is one of the two "principal points" of the lens, points whose positions depend upon the shape of the lens. The distance from the second principal point to the secondary focus is called the equivalent focal length of the lens or the E. F. L. And we shall find later that the distance from the front surface to the primary focus, or "front focal length", as it is called, is the reciprocal of the neutralizing power.

# FOCAL POWER OF OPHTHALMIC LENSES

## POWER OF A SPECTACLE LENS

There are four current expressions for power which should be clearly understood.

APPROXIMATE POWER ($D_1 + D_2$) - Let $D_1$ be the power of the front surface and $D_2$ be power or rear surface. Then $D_1 + D_2$ is a good approximation to the power of thin lens. It is found in all elementary text books and therefore is in current use among students. For accurate work and for thick lenses this approximation is not good enough.

EQUIVALENT POWER - In more advanced optical work power is commonly expressed as the reciprocal of the equivalent focal length. The term "equivalent power" distinguishes this definition from the others by a properly qualifying adjective. Equivalent focal length is a very useful conception and has an important application to a compound lens system, for it tells us where a single thin lens could be placed to give the same size of image. We shall endeavor to show the "equivalent power" which has been employed extensively in spectacle work is a less useful quantity than "effective power" as defined below.

EFFECTIVE POWER - The development and improvement in the design of spectacle lenses and trial sets has led to the introduction of the "back focus" and its reciprocal, "effective power". This is sometimes called "vertex refraction," which is a translation of the German "scheitol refraction," introduced by von Rohr. While the term "vertex refraction" is due to von Rohr (1912), the significance of the back focus was recognized much earlier. As early as 1908 the Optical Society (London) adopted the report of its Optical Standards Committee on the Standardization of Trial Cases in which the enclosed table gives not only the power of the trial lenses, but also the back focal length. We shall use the expression "effective power" and in the course of this paper we hope to justify the preference.

NEUTRALIZING POWER - We are all familiar with the practice of neutralization upon which the shopman relies so much. The basic idea of neutralization is very simple. For example, the shopman makes a -2D lens. He holds it against a +2D lens from the trial set. If the combination shows no power he is satisfied that the -2D lens is ground correctly. For weak powers this practice is without question; for higher powers it is readily proved that neutralization is not, in general, justified. In the report of the Standardization Committee referred to above, the use of trial lenses for neutralization purposes is carefully discussed. At that time the demand from manufacturers and others to maintain a neutralization basis for trial sets was so insistent that the following recommendation was offered and accepted. The negative lenses (bi-concave) were marked with their real "equivalent powers" and the positive lenses (bi-convex) were marked with corresponding "nominal" powers but were ground so as to neutralize the negatives. For example: A -20D lens was neutralized by a +20D lens, of which the true equivalent power was +18.83 D. A statement giving the true powers of the standard positives was required to be pasted in each trial case.

## NUMERICAL COMPARISONS

There are some single formulae for the calculation of equivalent power, effective power and neutralizing power. They are so simple in form that it is easy to make instructive comparisons showing upon what the numerical differences depend.

(1) Equivalent Power $= D_1 + D_2 - {}_sD_1\,D_2$

(2) Effective Power $= D_1 + D_2 + {}_sD_1^2 + \ldots$

(3) Neutralizing Power $= D_1 + D_2 + {}_sD_2^2 + \ldots$

$D_1$ = power of front surface

$D_2$ = power of rear surface

$s = \frac{\text{center thickness}}{\text{index of refraction}}$

The first formula is rigid; the other two are not. Each succeeding term of (2) and (3) beyond the third is smaller than the one preceding. In all but the higher powers the first three terms are sufficient. Effective power and neutralizing power can each be expressed by rigid formulae, but the forms given here serve better for the comparisons which we wish to make. In the numerical tables following the next term was included.

All three formulae contain $D_1+D_2$, i.e.; the sum of the powers of the front and rear surfaces, and the remaining term shows how much the power differs from this approximate expression which is so often used. Let us then consider the third term in each.

It is evident from the term $-_sD_1D_2$ in equation (1) that equivalent power depends upon the thickness and the powers of the two surfaces, but parallel light can enter from either side and the equivalent power remains the same. This may, at first sight, seem to be an advantage, but it will be shown later, from figures, that the power is the same because in one case it is measured from the second principal point and in the other from the first principal point.

We see from equation (2) that the third term is independent of the rear surface. Evidently then, effective power varies with the shape of the lens. If we reverse the direction from which parallel light enters, we change the effective power.

Similarly, the third term in (3) is independent of the front surface and varies with the shape of the lens. In fact there is a relation between (2) and (3). If we write $D_1$ for $D_2$ and $D_2$ for $D_1$ throughout in (3) we have (2). In other words, the neutralizing power of a lens is equal to its effective power when the lens is reversed. Suppose we have three positive lenses, the sum of the powers of the two surfaces being +16, one a bi-convex, another convexo-plane, and the third a meniscus with a −6 on the rear surface. The following short table shows what must be added to +16 to give equivalent power, effective power, and neutralizing power, respectively.

MSSS Chart # K-O-104 is a large table showing these quantities, from which it can be seen how they vary with the power of the lens and with the shape of the lens. Using the same example, a meniscus with rear surface −6 and front surface +22, $D_1+D_2$ = +16. The effective power differs from +16 by +2.30 D, its equivalent power is 0.57 greater and its neutralizing power is 0.15 greater. Evidently the effective power is 2.15 D greater than its neutralizing power; i.e., a meniscus −6, whose effective power is +18.30 would neutralize a lens whose effective power is −16.15 when the convex side of the meniscus is one of the contact surfaces.

Accompanying this article are given six figures corresponding to cases $D_1+D_2$ = +16 and $D_1+D_2$ = −16 in the tabulation given in MSSS Chart # K-O-104. In each case parallel light enters from the left; F is the secondary focus and H' the secondary principal plane. Similarly F and H are the primary focus and first principal plan respectively. Let us come back to the fundamental distinctions between the definitions for equivalent power, effective power, and neutralizing power.

| | Bi-Convex | Convexo-Plane | Meniscus—6 |
|---|---|---|---|
| Equivalent power | -0.28 | 0.00 | +0.57 |
| Effective " | +0.28 | +1.18 | +2.30 |
| Neutralizing " | +0.28 | 0.00 | +0.15 |

In any elementary text-book figures similar to figure 1 are given, showing the lens, the two foci, and the two principal planes. The primary focus F is the point from which the light of a point source diverging and entering the lens is rendered parallel upon emergence. The point F', the secondary focus, is the point to which entering parallel rays converge, or from which they appear to diverge upon emergence. The principal planes divide Fig. 1, AA' into three equal parts and HF = H'F'. Note from figures 1, 2, 3, that the principal planes move to the left as the shape of the lens changes. Similarly for the concave lenses, figures 4, 5, 6. It is true, in each case, as was said above, that the equivalent power is independent of the direction of the light, i.e., HF = H'F' but the planes H and H' are not fixed in relation to the lens, and it is clear that if a spectacle lens is measured in terms of equivalent power, the position of F' with respect to the lens depends upon the shape of the lens and is measured, in general, from some point within the lens.

It is for this reason that the back focal length and effective power have grown in favor until the best trial sets and lenses are designed and manufactured and marked so. Effective power is the reciprocal of A'F': so we always know, whatever the shape of the lens, how far back of the rear surface the focal point is situated. Its use implies, of course, that the spectacle shall be worn at some predetermined distance in front of the cornea: (this is true in any case). The distance 14 mm. has been universally adopted because at this distance magnification of objects is unity.

EFFECT UPON THE EYE OF POSITION OF THE LENS - There is a curious custom which has a bearing on the question of the proper position of spectacles. It is sometimes observed that a person who should wear bifocal glasses lowers his spectacles for distant vision far down on the bridge of his nose while reading. This habit has a simple scientific explanation; the spectacles so worn are stronger in effect, as the figure 7 will show. Suppose a lens in position L (figure 7) brings light to a focus at F', which is distant the length AF' from the point A. If we move the lens away from A the focal point moves nearer A; i.e., with respect to that point.

A formula to express this idea of change in power with respect to a point A as the lens is moved is found in Laurance, General and Practical Optics, Page 192. It will be found upon reading that Laurance uses the term "effective power" also, and in a larger sense than is used here, but there is no conflict of definition. He makes the statement: "If any lens is in contact with a given plane, then the effectivity at that plane is represented by the power of the lens itself". This is equally valid whether we think in terms of EFL or back focus. Now in the design of spectacles the point A may be at the cornea or at any fixed known distance from it. Since the point 14 mm. in front of the cornea has the distinction of giving unit magnification, and spectacles are worn at this position, this should be the fixed point of reference with respect to which power is measured. Regardless of

the shape of the lens, the position of the focal point in relation to the eye is known. In other words, effective power, as we have defined it, gives the true corrective effect of the lens upon the eye. The lens should be designed for this corneal distance, the trial set should be marked with effective powers, the trial frame should have adjustment for corneal distance and the spectacles should be worn at the same distance. It is just as important to wear a carefully designed lens at 14 mm. as it is to make the lens calculations for this distance. Suppose a +10 D lens (effective power) is designed to be worn at 14 mm. and is worn at 16 mm. The back focus is 100 mm. and an increase of 2 mm. gives an effect upon the eye of

$$\frac{1}{0.098} = 10.2D$$

MARGINAL POWER - Lens design has now reached the point where the lens errors near the margin are reduced. Suppose we are concerned with such a design. How is "effective power" measured near the margin? In correcting marginal error we are concerned with oblique vision or the motion of the eye about its center of rotation. Evidently then we should measure back focal length always from a distance 14 mm. from the cornea, (27 mm. from the center of rotation), and the effective power is then referred, not to a plane, but to a circle of 27 mm. radius.

EFFECTIVE POWER VS. VERTEX REFRACTION - The expressions "vertex refraction" and "effective power" mean the same thing at the center of the lens, but vertex refraction can have no meaning, except at the center, for the vertex is the intersection of the optic axis and the center of the rear surface. Neither does it have as direct a suggestion of meaning. By effective power we mean power so measured that it gives directly the corrective effect of the lens upon the eye when it is worn at the universally adopted distance of 14 mm.

RELATION BETWEEN EFFECTIVE POWER AND NEUTRALIZING POWER - Effective and neutralizing powers bear a simple relation to each other. That two lenses having a common axis shall neutralize, only one condition needs to be fulfilled: namely, that the secondary focus of the first shall coincide with the primary focus of the second. The lenses may or may not be in contact. (Two negatives cannot be made to neutralize because both foci are virtual, but two positives on opposite sides of the common focal point will neutralize.) Suppose parallel light enters a positive lens and is converging toward F'. Then if a negative lens is placed in the converging beam so that its primary focus F coincides with F', it will render the beam parallel upon emergence by definition of primary focus.

Now neutralization of ophthalmic lenses is always accomplished by holding the lenses in contact, hence the second lens must have a front focal distance equal to back focal distance of the first lens. Neutralizing power is defined to be the reciprocal of the front focal distance. Now front focal length becomes back focal length when the lens is reversed, hence neutralizing power is equal to the effective power of the lens reversed and a single formula serves for both as mentioned above, provided due regard is shown for the interchange of $D_1$ and $D_2$.

NEUTRALIZATION - In making neutralization tests we have to remember that effective power and neutralizing power are numerically interchangeable with reversal of the lens and that the front surface of the known lens must be one of the surfaces of contact. The other surface of contact will be the rear surface of the unknown lens.

To bring out the same idea in a somewhat different way: Suppose a bi-concave trial lens is used to neutralize a strong positive meniscus. If the course of

entering parallel light is followed through the combination with convex surface against concave (Light may enter from either side) it will be seen that the power of the meniscus given by neutralization is measured from the convex surface; i.e., the lens should be worn with convex surface toward the eye.

It might seem at first sight that a bi-convex lens would neutralize a bi-concave lens of the same curvature. This is true for weak powers only. If we draw a cross section of the lenses and extend the outside curves it is at once evident that the combination is a section of a larger lens of meniscus shape which is essentially positive (figure 8). This was clearly brought out in a pamphlet entitled "Why Strong Contra-Generic Lenses of Equal Power Fail to Neutralize Each Other", by Charles F. Prentice, 1899.

For perfect neutralization of a strong bi-convex and bi-concave it is necessary that the curvature of the concave lens shall be a little steeper. This means a very thin air space at the center. In practice, however, neutralizing sets are manufactured including 20D. This is accomplished by reducing the diameters. The lenses are designed to have equal effective powers and although they cannot be made to neutralize, theoretically speaking, they do so in practice, for the very small difference from complete neutralization is less than the eye can readily observe, amounting to a maximum of 0.04D. for a lens 40 mm. in diameter.

## SUMMARY AND CONCLUSIONS

(1) From the above considerations of theory and practice and development of the spectacle industry, it is of importance to recognize the physical significance of the power of a lens and to know its several meanings and uses.

(2) We have seen that the important characteristic of a lens is its effect upon the eye and that this depends not only upon the curves of the two surfaces, but also upon the thickness, the shape and position before the eye.

(3) Neutralization must be practiced with discrimination if used at all.

(4) Trial sets and newly designed spectacles are calculated for and marked with effective power. The meniscus lens is very largely used and will continue to be used, for it gives a wider field of vision and is capable of better marginal correction. With these developments we must have a clearer understanding of power and neutralization and of the relation between them.

## LENS MEASURES

A word about devices for measuring lenses may not be amiss. First let us dispose of lens gauges by saying that too much must not be expected of them. The gauge itself may be extremely well made, but its use as a lens measure taxes the ability of the best instrument maker. It does not determine the power of a lens; it merely measures surface curvature. It is nothing more than an extremely accurate depth gauge. If we assure the distance between the outside points to be 20 mm., the plunger moves about 0.10 mm. per diopter. Therefore, a motion of only 0.001 mm. changes the reading 0.01D. The machined parts must be true to better than the fineness of a good timepiece to give an average accuracy of 0.03D. Only the very best workmanship will produce a gauge in which there is not a single error as great as 1/8 D. The real usefulness of a gauge consists in rapidly finding to what series a lens belongs and it can also be used with considerable accuracy in testing the uniformity of like surfaces.

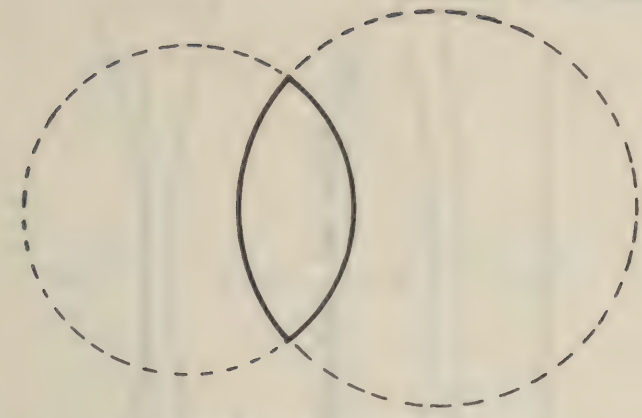
## FOCAL POWER OF OPHTHALMIC LENSES

### LENS TESTING

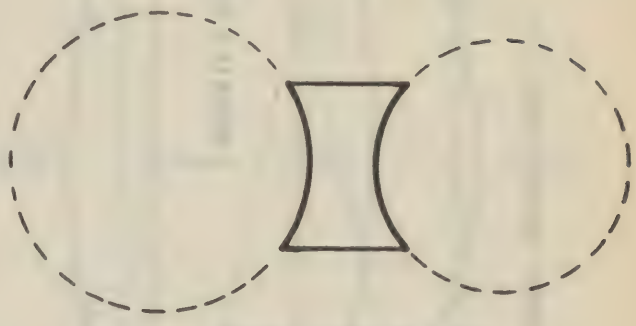
The best method of verifying lens power is by the use of a Lensometer or similar instrument. Speaking of the Lensometer only, with which we are the most familiar, here is an instrument which measures to the same order of accuracy to which the lenses are made. An experienced operator, using an instrument in correct adjustment, can read to 0.03 D. The optical principles underlying the construction of this instrument are such that it reads directly the effective power of a single lens or a succession of lenses as the case may be.

FOCAL POWER OF OPHTHALMIC LENSES

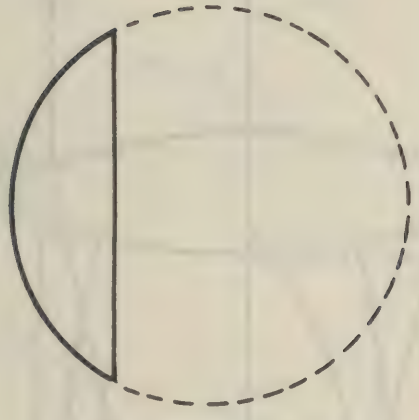
DIAGRAM - MSSS I-0-104b
FORMS OF LENSES



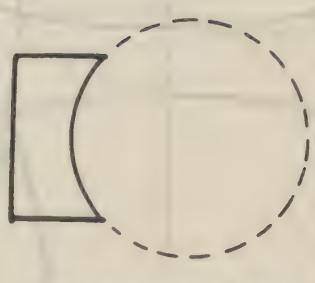
DOUBLE CONVEX LENS
FIGURE 1



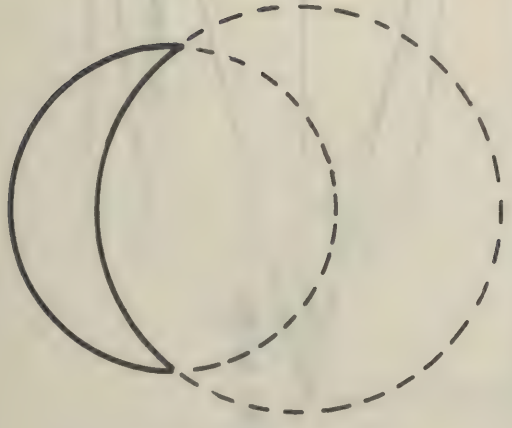
DOUBLE CONCAVE LENS
FIGURE 4



PLANO-CONVEX LENS
FIGURE 2



PLANO-CONCAVE LENS
FIGURE 5

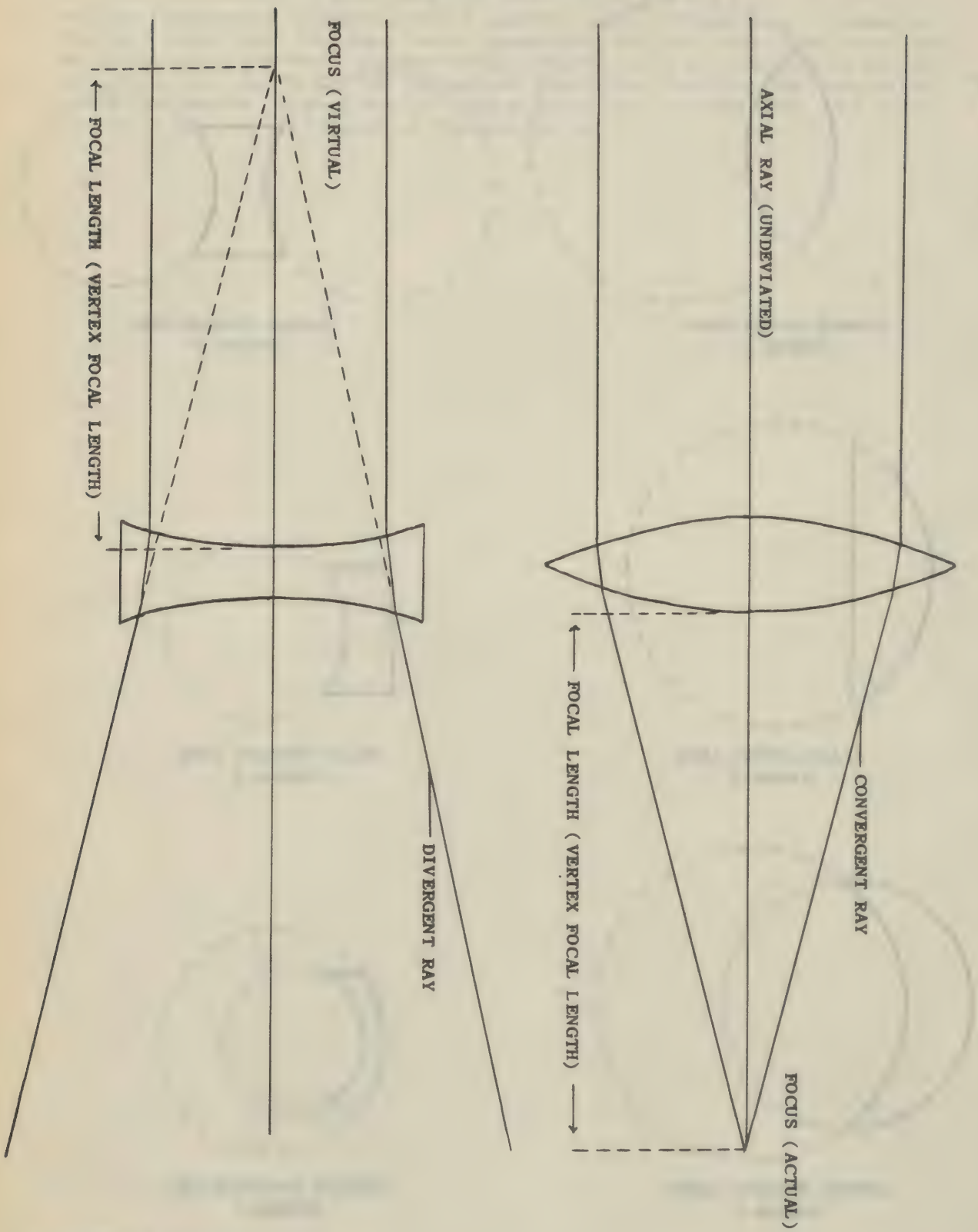


CONVEX MENISCUS LENS
FIGURE 3

CONCAVE MENISCUS LENS
FIGURE 6

FOCAL POWER OF OPHTHALMIC LENSES

DIAGRAM - MSSS I-0-104c
DEVIATION OF LIGHT RAYS BY A LENS



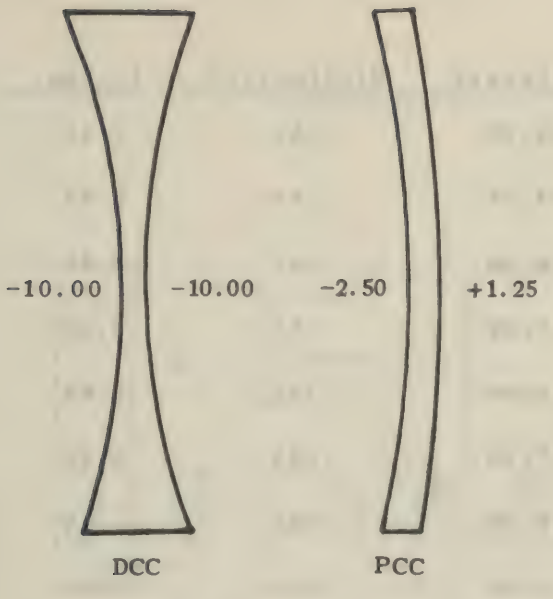



Figure 8

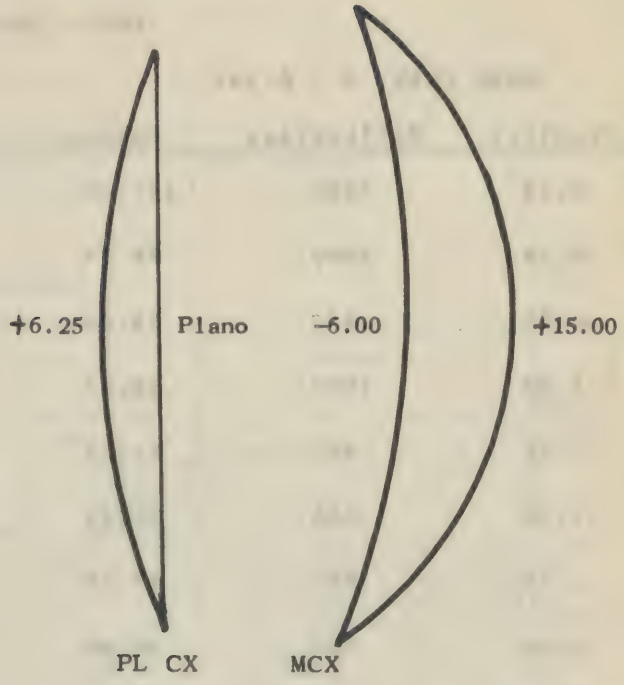



Figure 9

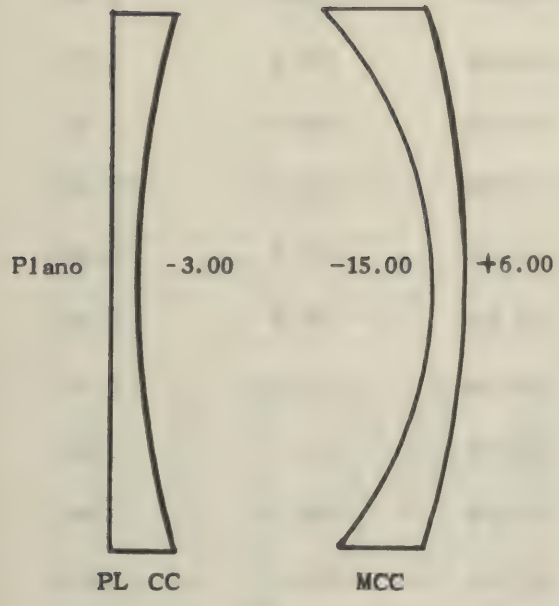



Figure 10

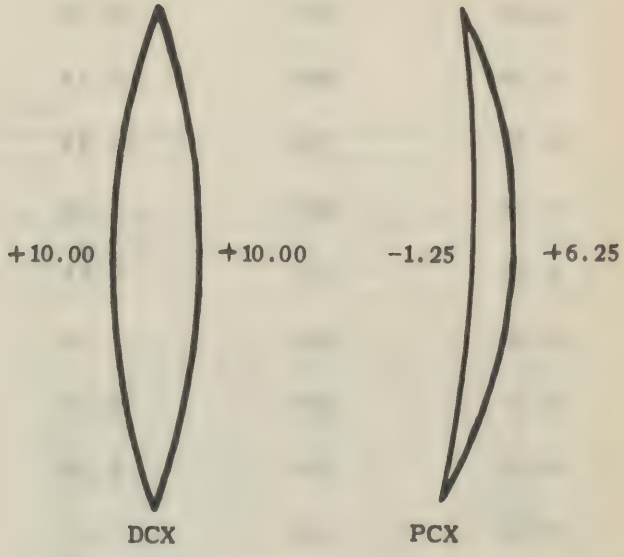



Figure 11

DIAGRAM - MSSS I-0-104d
Types of lenses

## FOCAL POWER OF OPHTHALMIC LENSES

### FOCAL LENGTHS

MSSS CHART A - 0-104

| Diopters | Millimeters | Inches | Diopters | Millimeters | Inches |
|---|---|---|---|---|---|
| 0.25 | 4000 | 157.48 | 5.50 | 182 | 7.16 |
| 0.50 | 2000 | 78.74 | 5.75 | 174 | 6.85 |
| 0.75 | 1333 | 52.49 | 6.00 | 167 | 6.56 |
| 1.00 | 1000 | 39.37 | 6.50 | 154 | 6.06 |
| 1.25 | 800 | 31.50 | 7.00 | 143 | 5.62 |
| 1.50 | 666 | 26.25 | 7.50 | 133 | 5.25 |
| 1.75 | 572 | 22.50 | 8.00 | 125 | 4.92 |
| 2.00 | 500 | 19.68 | 8.50 | 118 | 4.63 |
| 2.25 | 444 | 17.50 | 9.00 | 111 | 4.37 |
| 2.50 | 400 | 15.75 | 9.50 | 104 | 4.14 |
| 2.75 | 364 | 14.32 | 10.00 | 100 | 3.94 |
| 3.00 | 333 | 13.12 | 10.50 | 95.4 | 3.75 |
| 3.25 | 308 | 12.11 | 11.00 | 90.9 | 3.58 |
| 3.50 | 286 | 11.25 | 11.50 | 88.1 | 3.42 |
| 3.75 | 267 | 10.50 | 12.00 | 83.3 | 3.28 |
| 4.00 | 250 | 9.84 | 13.00 | 76.9 | 3.03 |
| 4.25 | 236 | 9.26 | 14.00 | 71.4 | 2.81 |
| 4.50 | 222 | 8.75 | 15.00 | 66.7 | 2.62 |
| 4.75 | 211 | 8.29 | 16.00 | 62.5 | 2.46 |
| 5.00 | 200 | 7.87 | 17.00 | 58.8 | 2.32 |
| 5.25 | 191 | 7.50 | 20.00 | 50.0 | 1.97 |

TABLE I

Difference between { Equivalent power / Effective " / Neutralizing " } and $(D_1+D_2)$

*Positives*

| $D_1+D_2$ | Equivalent | | | | Effective | | | | Neutralizing | | | | Thickness |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Bi-Convex | Convexo Plane | Meniscus $D_2=-3$ | Meniscus $D_2=-6$ | Bi-Convex | Convexo Plane | Meniscus $D_2=-3$ | Meniscus $D_2=-6$ | Bi-Convex | Convexo Plane | Meniscus $D_2=-3$ | Meniscus $D_2=-6$ | |
| 0 | 0.00 | 0.00 | +0.01 | +0.03 | 0.00 | 0.00 | +0.01 | +0.03 | 0.00 | 0.00 | +0.01 | +0.03 | 1.2m |
| +2 | 0.00 | 0.00 | +0.02 | +0.06 | 0.00 | +0.01 | +0.03 | +0.08 | 0.00 | 0.00 | +0.01 | +0.05 | 1.9 |
| +4 | —0.01 | 0.00 | +0.04 | +0.10 | +0.01 | +0.03 | +0.08 | +0.17 | +0.01 | 0.00 | +0.01 | +0.06 | 2.6 |
| +6 | —0.02 | 0.00 | +0.06 | +0.15 | +0.02 | +0.08 | +0.17 | +0.32 | +0.02 | 0.00 | +0.02 | +0.08 | 3.1 |
| +8 | —0.04 | 0.00 | +0.09 | +0.22 | +0.04 | +0.17 | +0.32 | +0.53 | +0.04 | 0.00 | +0.02 | +0.09 | 3.8 |
| +10 | —0.08 | 0.00 | +0.12 | +0.30 | +0.08 | +0.32 | +0.55 | +0.84 | +0.08 | 0.00 | +0.03 | +0.11 | 4.6 |
| +12 | —0.12 | 0.00 | +0.15 | +0.37 | +0.12 | +0.52 | +0.80 | +1.16 | +0.12 | 0.00 | +0.03 | +0.12 | 5.1 |
| +14 | —0.19 | 0.00 | +0.19 | +0.46 | +0.19 | +0.79 | +1.18 | +1.65 | +0.19 | 0.00 | +0.03 | +0.13 | 5.7 |
| +16 | —0.28 | 0.00 | +0.25 | +0.57 | +0.28 | +1.18 | +1.70 | +2.30 | +0.28 | 0.00 | +0.03 | +0.15 | 6.4 |
| +18 | —0.39 | 0.00 | +0.30 | | +0.41 | +1.68 | +2.36 | +3.12 | +0.41 | 0.00 | +0.03 | +0.17 | 7.2 |
| +20 | —0.49 | 0.00 | | | +0.51 | +2.17 | +2.91 | | +0.51 | 0.00 | +0.03 | | 7.3 |

*Note*—This table is based upon the first four terms of Formulae 2 and 3. Index, 1.500.

*Negatives*

| $D_1+D_2$ | Equivalent | | | | Effective | | | | Neutralizing | | | | Thickness |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Bi-Concave | Plano-Concave | Meniscus $D_1=+3$ | Meniscus $D_1=+6$ | Bi-Concave | Plano-Concave | Meniscus $D_1=+3$ | Meniscus $D_1=+6$ | Bi-Concave | Plano-Concave | Meniscus $D_1=+3$ | Meniscus $D_1=+6$ | |
| 0 | 0.00 | 0.00 | +0.01 | +0.03 | 0.00 | 0.00 | +0.01 | +0.03 | 0.00 | 0.00 | +0.01 | +0.03 | 1.2mm |
| —2 | 0.00 | 0.00 | +0.01 | +0.04 | 0.00 | 0.00 | +0.01 | +0.03 | 0.00 | 0.00 | +0.02 | +0.05 | 1.2 |
| —4 | 0.00 | 0.00 | +0.01 | +0.04 | 0.00 | 0.00 | +0.01 | +0.02 | 0.00 | +0.01 | +0.04 | +0.07 | 1.0 |
| —6 | —0.01 | 0.00 | +0.01 | +0.04 | 0.00 | 0.00 | 0.00 | +0.02 | +0.02 | +0.02 | +0.05 | +0.08 | 0.7 |
| —8 | —0.01 | 0.00 | +0.01 | +0.04 | +0.01 | 0.00 | 0.00 | +0.02 | +0.01 | +0.03 | +0.06 | +0.09 | 0.7 |
| —10 | —0.01 | 0.00 | +0.01 | +0.05 | +0.01 | 0.00 | 0.00 | +0.02 | +0.01 | +0.05 | +0.08 | +0.13 | 0.7 |
| —12 | —0.01 | 0.00 | +0.01 | +0.05 | +0.02 | 0.00 | 0.00 | +0.02 | +0.02 | +0.07 | +0.12 | +0.17 | 0.7 |
| —14 | —0.02 | 0.00 | +0.02 | +0.06 | +0.02 | 0.00 | 0.00 | +0.02 | +0.02 | +0.09 | +0.14 | +0.20 | 0.7 |
| —16 | —0.03 | 0.00 | +0.02 | +0.07 | +0.03 | 0.00 | 0.00 | +0.02 | +0.03 | +0.13 | +0.17 | +0.24 | 0.7 |
| —18 | —0.04 | 0.00 | +0.02 | +0.07 | +0.04 | 0.00 | 0.00 | +0.02 | +0.04 | +0.17 | +0.21 | +0.29 | 0.7 |
| —20 | —0.05 | 0.00 | | | +0.05 | 0.00 | 0.00 | +0.02 | +0.05 | +0.20 | +0.27 | | |

# SECTION VI

# FACIAL MEASUREMENTS

# FACIAL MEASUREMENTS

All the necessary facial measurements for making a pair of glasses can be done with a millimeter rule. These measurements should be verified, where possible, with a frame from stock corresponding to the measurements taken.

The first measurement is the interpupillary distance. This is the distance, expressed in millimeters, between the center of the pupils, commonly abbreviated as P.D. There are several methods of taking this reading but the most satisfactory is as follows: Seat the patient, facing you, about 16 to 18 inches from you. Hold the P.D. rule in the right hand between the thumb and the forefinger. Lay the rule across the bridge of the patient's nose so that it will extend to cover both pupils. Steady your hand by placing the 4th and 5th fingers against the side of the patient's face. Instruct the patient to look at the pupil of your left eye. Close your right eye and sight the initial mark of the rule on the outside of the patient's right pupil with your left eye. Now instruct the patient to look at the pupil of your right eye. Hold the rule steady on the face and open your right eye and sight the inside of the patient's left pupil over the rule noting the millimeter reading indicated on the rule. To get an accurate reading it is imperative that the rule be held steady during the entire operation. You can check on the reading by having the patient repeat the whole process while you recheck your readings. The advantage of this method lies in the fact that the patient is looking straight forward or at infinity as far as convergence is concerned while the measurement is being taken. This is seen by the fact that each eye when measured is looking straight forward.

The near P.D. may be taken in a number of ways, any of which are good as long as the patient is converging to his normal reading point. You may have the patient look at the center of your forehead or any other convenient point at that distance.

Distance between lenses commonly referred to as D.B.L., is the next measurement. This is most easily accomplished by measuring across the nose to the points where the pads would normally rest and adding 4 mm. to this measurement. If, however, your D.B.L. is in even numbers on the frame and the measurement comes out to be odd, add not more than one millimeter to the whole. It is better not to reduce the measurement because this may result in the eye-wires touching the side of the nose. If, however, you have a patient with a thin high nose this is permissible.

The next measurement is to take the width of temples one inch back of the temple joint. This is done with the inch rule that is incorporated on the P.D. rule. Hold the ruler across the patient's face and measure one inch back of the joint, or about the lateral edge of the eye socket, in much the same manner as you measured the P.D. Add one quarter inch to the reading.

Length of temple to back of the ear is next. Place the index finger back of the ear in such a manner that the tip of the finger will rest at the point where the temple first touches the ear. Place the ruler against the tip of the finger and sight over the ruler at the front of the cornea, add 1/2 inch to this measurement for the length to top of ear. To this add 2 inches for the total length of the riding-bow temple.

The angle of joint of the temple cannot be taken with a ruler. In the ful-vue frame, the standard is 10 degrees pantoscopic for standard wear, and 13 degrees for reading only. This may be adjusted when the glasses are dispensed.

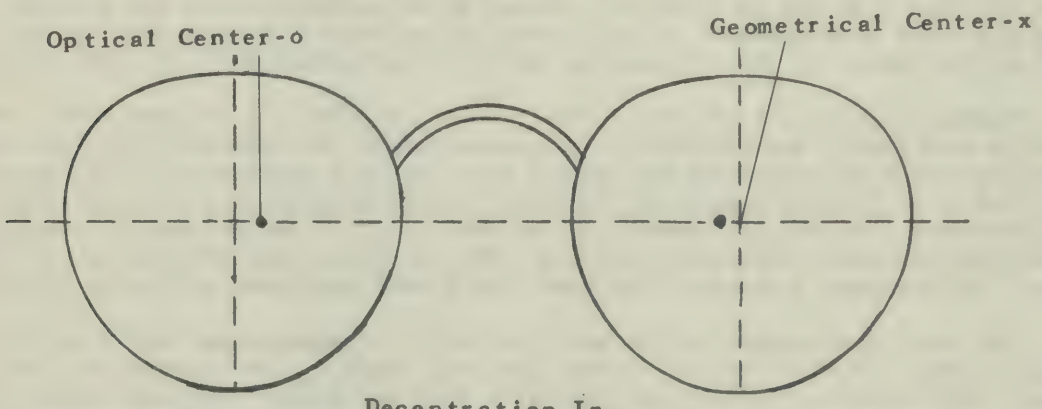
In the Army program only the drop pattern having a 3 mm. difference will be used. The ideal method is to take the D.B.L. from the P.D. for the eyesize. Example: P.D. 64, D.B.L. 22, 64-22 equals 42 eyesize. It may be necessary to

have a larger or smaller eyesize because of the patient's facial characteristics. A man having a broad face with bulging temples would take a larger eyesize and a man having a thin narrow face would take a smaller eyesize. This is dictated by cosmetic appearance and comfort rather than necessity.

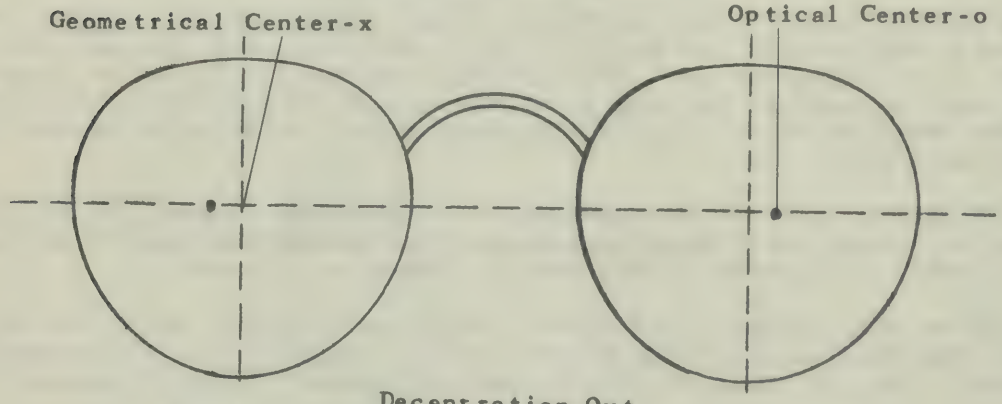
After all possible measurements have been taken or estimated, a frame should be taken from stock corresponding as nearly to the measurements found as possible, and tried on the patient to verify the measurements and estimations that you have made and the necessary corrections noted.

The importance of an accurate interpupillary distance (P.D.) cannot be overemphasized. In any job it is necessary to have an accurate plan or blueprint to follow, to have the finished product accurate. The refractionist takes great pains in his examination to give the optician the exact formula for the resultant power of the lenses to be used. It is the optician's job to fashion the spectacles in such a manner that the accuracy of this formula is not destroyed in the making of the spectacles. The facial measurements are the blueprints made by the optician. The primary basis of this blueprint is the interpupillary distance (P.D.) measurement. If the interpupillary distance (P.D.) is not accurate, a prism will be incorporated in the finished lens that is not called for in the Rx. This will cause discomfort to the patient and discredit to the optician.

M. S. S. S. DIAGRAM F-0-0 10 5




Decentration In
Showing decentration of 3 mm. in each lens.
Total decentration 6 mm.




Decentration Out
Showing decentration of 3 mm. out, each lens.
Total decentration 6 mm.

In many cases it will be found necessary to decenter the lenses in some manner. This is done so that the patient will look through the optical centers of the lenses.

Each lens has two centers, an optical center and a geometrical center. They may or may not be at the same place in the finished lens. Decentration is the moving of the optical center from the geometrical center.

An example of decentration to obtain the proper interpupillary distance (P.D.) is as follows: The patient has an interpupillary distance (P.D.) of 64 mm. Due to facial characteristics and size of head, it is necessary to use the following frame: Distance between lenses (D.B.L.) 24 mm.; eyesize 46 mm.; the frame interpupillary distance (P.D.) is 70 mm. To have the patient look through the optical centers of the lenses it will be necessary to decenter each lens in 3 mm., or a total of 6 mm. Should this patient be wearing a plus 5.00 over each eye, and the decentration not done, the resultant prism would be 3 prism diopters that the Rx did not call for. Examples of decentration are shown on preceding page.

# SECTION VII

# INTERPRETATION OF PRESCRIPTION

# INTERPRETATION OF PRESCRIPTION

The prescription should come to the optical repair unit completely filled out on the proper form and properly signed. However, due to the congestion in some installations and the carelessness or inexperience of the recorders involved, many prescriptions will contain only a minimum of information. It will be the concern of the unit operators to properly interpret the prescription and perform the necessary mechanical work involved.

Prescription forms may vary greatly and in some instances be written on plain piece of paper but all should contain the following information in some form.

(Full Name of Individual) Serial No. Rank Co., Regt. or Corps

P.D. Far Near D.B.L. Temple Length Eye Size

| | | SPH. | CYL. | AXIS | PRISM | BASE | DEC. |
|---|---|---|---|---|---|---|---|
| Distance | R | | | | | | |
| | L | | | | | | |
| Add | R | | | | | | |
| | L | | | | | | |

Repair:

Case:

Special Instructions:

Station

Date

(Signature)

(Rank and Organization)

Each prescription will be checked by the unit clerk and a number assigned to it. He will see that the necessary information is present, transfer the prescription to the work order, exercising care that the plus and minus signs have not been inverted and that the decimal points are between the proper digits.

Should the original prescription be written as minus cylinders the clerk will make an accurate transposition at the time he transfers the original to the work order. Inasmuch as minus cylinders are not stocked or ground, the practice of always transposing prescriptions to read as plus cylinders will tend to eliminate the common error of processing lenses ninety degrees off axis.

Transposition must be thoroughly understood by each member of the unit personnel as it is the greatest single factor in the interpretation of the prescription.

By definition: To transpose a lens is to change its curves or designation without changing its refractive value.

The basic rule of transposition provides that when two cylinders of equal power and of similar sign are crossed at right angles, they produce the effect of a spherical lens of the same power as one of the cylinders.

PLANE CYLINDER TO A SPHERO-CYLINDER - The sphere will be the same sign and power as the cylinder. The cylinder will remain the same power but opposite in sign and axis.

Example: +1.00c axis 90 = +1.00s ⊃ - 1.00c axis 180

SPHERO-CYLINDER

+ ⊃ to + ⊃ - or - ⊃ - to - ⊃ +

Add the cylinder to the sphere and reverse the sign and axis of the cylinder.

Example: + 1.00s ⊃ +1.00c axis 90 = +2.00s ⊃ - 1.00c axis 180

Example: - 1.00s ⊃ - 1.00c axis 90 = - 2.00s ⊃ + 1.00c axis 180

SPHERO-CYLINDER

+ ⊃ - or - ⊃ +

When the cylinder is stronger, subtract the sphere from the cylinder and reverse the signs of both the sphere and the cylinder and the axis of the cylinder.

Example: + 1.00s ⊃ - 2.00c axis 90 = - 1.00s ⊃ +2.00c axis 180

When the sphere is the stronger, subtract the cylinder from the sphere to obtain the sphere and reverse the sign and axis of the cylinder.

All these rules may be condensed as follows:

Subtract the smaller from the larger for the sphere, keeping the sign of the larger. Change the sign of the cylinder and reverse the axis.

The placing of decimal points cannot be overemphasized. Make sure they are never omitted and that they are properly inserted. Always place a zero before the decimal point when indicating powers of less than one diopter.

Example: Right + 0.50

Wrong + .50

Always carry fractions of a diopter to two places.

Example: Right + 1.50

Wrong + 1.5

If a prescription is obviously incorrect, it is advisable to contact it's source of origin if possible and ask for verification.

For example:

Right: + 7.5 +0.75 x 90

Left: + 0.75 +0.75 x 90

The spherical power of the right lens is incorrectly written for either a lens of seven and one half diopters or three fourths of a diopter. Either interpretation could easily prove incorrect. If verification from the source of the prescription or from spectacles being worn by the patient is unavailable, the problem will be referred to the Unit Commander for decision who will make a notation on the prescription as to which lens was supplied.

Although the following prescription may be correct, it has the appearance of being improperly written.

R. + 2.00 + 2.00 x 45

L. + 2.00 - 2.00 x 135

It is probable that the sign of the cylindrical power of the left lens was intended to read plus instead of minus. Upon transposing the left lens to a plus cylinder it can be readily seen that the prescription would have two reasonably strong cylinders at the same oblique axis. Although this condition does happen, it is against the general rule and should be verified.

The logical assumption is that the sign of the left cylinder has not been completed. This is such a common error that many civilian opticians use the following procedure when making plus or minus signs.

Always make the vertical stroke of the plus sign first and then the horizontal stroke. If you are then interrupted during the procedure you will have a vertical stroke and the error is apparent at once. Whereas, if you had made the horizontal stroke first and then neglected to complete the sign, the prescription would be processed for a minus instead of a plus lens and would be of no value to the wearer.

The minimum information that can be contained in the prescription and still permit proper processing is as follows: Sphere power, cylinder power and axis (if cylinder is present) and the Interpupillary distance (P.D.) or it's equivalent. If the eyesize and the distance between lenses (D.B.L.) are given, assume they represent an accurate P.D., and that no decentration was intended.

If any other information is omitted it may be filled in from previous experience and the known averages: Average D.B.L., 22 mm. Average temple length 6½". The eyesize will be consistent with the D.B.L. and P.D.

The lense patterns consist of two shapes. Round for gas mask inserts and a P3 drop shape for government issued spectacles.

## INTERPRETATION OF PRESCRIPTION

Always exercise extreme care in interpretation, transferring and the transposition of prescriptions. The greatest margin of probable error lies within these three procedures.

Work properly processed the first time will increase the production capacity, reduce the percentage of stock loss and thereby reduce the amount of stock and supplies that it will be necessary to requisition.

The foregoing must be observed and put into daily practice in order that each unit or installation may blend itself into the Army program of constant improvement.

# SECTION VIII

# ADJUSTING AND FITTING

ADJUSTING - Glasses are adjusted to make them as comfortable as possible while maintaining the correct alignment for efficient vision. A pair of glasses may be in perfect visual alignment and still appear crooked on the patient's face due to irregularities of the features. This may be corrected by the proper adjustment of the glasses.

Adjusting becomes tiresome to the patient if the glasses are put on and taken off for each slight bend. To make the process more efficient and less tiring to the patient, make as many adjustments as possible at each trial.

When adjusting a pad bridge spectacle, the first step is to shape the guards to lie evenly and loosely against the sides of the nose. To make this adjustment it is not necessary to place the glasses on the patient with the temples over the ears. Hold the glasses by the rims with the temples spread as far as possible, place the bridge to the nose and note the pad adjustments necessary. At the same time note whether the temples should be spread, narrowed, or curved to conform with the sides of the head. Shape the guards to conform with the nose, being sure that they do not squeeze the nose. Shape the temples to conform with the head. If the temples bind or touch the sides of the head, file the check lug on the butt of the temple until you have the proper spread. Round the temple shaft with the thumb and first two fingers of the hand until the temple shafts do not press against the sides of the head.

Next, place the glasses on the patient with the temples over the ears. Turn the patient's head until you have a side view. Notice the position of the guards, the pantoscopic or retroscopic tilt, and the point where the temple fits the top of the ear. Remove the glasses and make the necessary adjustments and also shape the temple to the back of the ear.

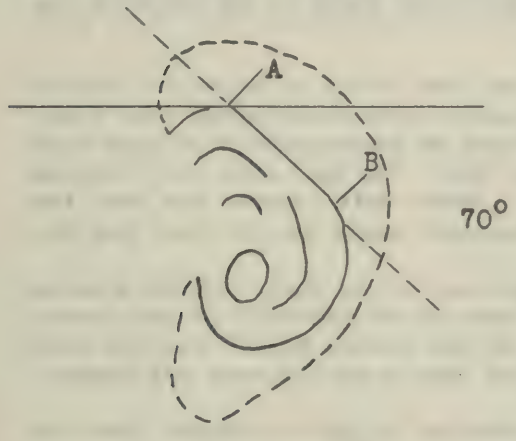



Fig. 1

On the back of the ear there is a flat space running from the top where temple first touches (A. Fig. 1) to the high spot half way down the back of the ear. (B. Fig. 1). This flat part is usually at about a 70 degree angle. The temple should be shaped to lie flat between these two points. The high spot on the back of the ear is very sensitive and will become sore with very little pressure. Make a sharp bend in the temple here to distribute the temple pressure equally between the flat of the ear and the curve below the high spot. The temple should be curved outward from the lobe depression of the ear, because this is another sensitive portion of the ear. Although a riding bow temple of the correct length will extend to the center of the lobe of the ear, the tip of the temple should be shaped so that it will not press or dig into this portion.

To shape a temple to conform with the ear, grasp the shaft of the temple with the left hand to steady it. Place the forefinger of the right hand under the temple at the point where the temple first touches the ear. Place the third finger about 1/8 inch down from the forefinger on the underneath side, and the thumb between the fingers on the top side. By exerting pressure with the thumb and

holding the shaft steady with the left hand the bend necessary at the top of the temple and the flat portion can be formed at the same time. Using the same method make the bend at the high spot of the ear but do not flatten the temple below the second bend. Then using the concave convex plier bend the tip of the temple outward. These bends should make the temple lie evenly along the back of the ear. If the bends do not lie in the proper place rebend until the proper distribution is obtained. After one temple is shaped correctly the other temple can be shaped, using the first as an example. After the temples have been shaped it will be necessary to replace the glasses and note the guard adjustment, pantoscopic or retroscopic angle, and the parallelism of the lenses to the face and make the necessary readjustments.

If the lenses are too close to the cheeks, and too far from the eyebrows, the temples should be bent retroscopic, or upward. If the lenses are too close to the eyebrows and too far from the cheeks the temples should be bent pantoscopic, or downward. The phrase "bend the temples" is not correct, the actual bending is done with the endpiece. To accomplish this, grasp the endpiece, with a curved shank angling plier, as close to the eyewire as possible. Holding the angling plier in the left hand with the plier turned in such a manner as to have the hand as far under the glasses as possible. Grasp the protruding endpiece with a parallel jaw or snipe nose plier and twist the endpiece until the open temple is at the desired angle. After shaping one temple to the desired angle the other endpiece can be twisted in the same manner until the temples are equal.

The next step in adjusting is to note if the glasses are straight on the face, if one lens is higher or lower than the other. In this alignment the eyebrows are a poor line to follow because of their width, and the fact that they often vary in height on the same person. The easiest and surest line to follow is the line of the roots of the lower cilia. Mark the lenses about 2 mm. below the geometrical center (using a grease pencil or ink) and sight these marks with the lower cilia. In adjusting bifocals mark the top of each segment and sight these on the roots of the lower cilia.

In adjusting to make lenses straight on the face raise or bend the temple toward pantoscopic on the low side, or bend the temple retroscopic on the high side. The bending of one or both temples in a retroscopic or pantoscopic direction does not raise or lower the glasses as a whole on the face. The nose acts as a fulcrum and as one side is lowered the other is raised. Where both temples are bent the effect is to increase the pantoscopic or retroscopic angle as the case may be.

The next step is to note the height of the glasses on the face. If the glasses are too low on the face first see if the temple tension is correct. If the temple tension is correct and the glasses are still not of the correct height then the only way they can be adjusted is to lower or raise the guards as the case may demand.

Next note the position of the lenses in relation to their distance from the eye and particularly the lashes. The lenses should set 13.5 mm. from the cornea, this is the anterior nodal point of the eye and the ideal distance. They should never touch the lashes. If the lenses are too far from the eyes, the easiest adjustment is to widen the spread of the pads. This may cause the curl of the guard arm to come too close to the eye, if this is the case the guard arm must be shortened. If the lenses touch the lashes, narrow the pad spread, without pinching the nose; otherwise the guard arms must be lengthened.

Notice the distance of each lens individually from the eye. If one lens is closer than the other it means that the temple tension is unequal. For this adjustment shorten the top or back-of-ear tension on the lens side that is too far from the eye, or loosen the back-of-ear tension on the side that is too close to the eye. Which adjustment to make will depend on the overall tension produced by the adjustment. To be sure of equal temple tension, place the glasses on the patient; holding each endpiece by the tip of the first finger, pull the glasses slightly from the nose and see if they fall back on the nose evenly.

The last step is to note if the glasses fit perfectly, and that each lens is equal distance from the nose, if the nose is normal, and adjust accordingly.

PROCEDURE - Step number one is to see that the lenses are straight in a rim, or that they are firmly mounted in a rimless, and that the glasses are true in alignment.

Step number two for a pad bridge frame or mounting spectacle, have the pads lie evenly or flat on the sides of the nose and the temples spread so as not to bind on the sides of the head.

Step number three is to shape the temples to conform to the back of the ear, and bend the endpieces to the desired pantoscopic or retroscopic tilt.

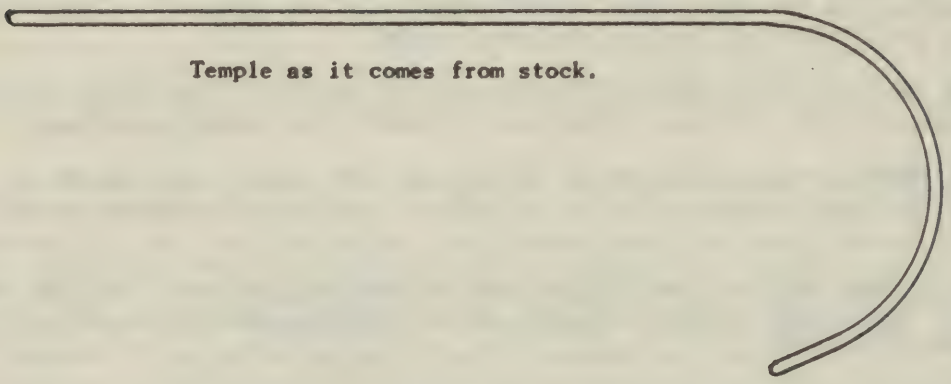
Step number four is to note the height or parallel position of each lens on the face, raising or lowering by retroscopic or pantoscopic tilt of the endpiece.

Step number five is the height of the glasses on the face.

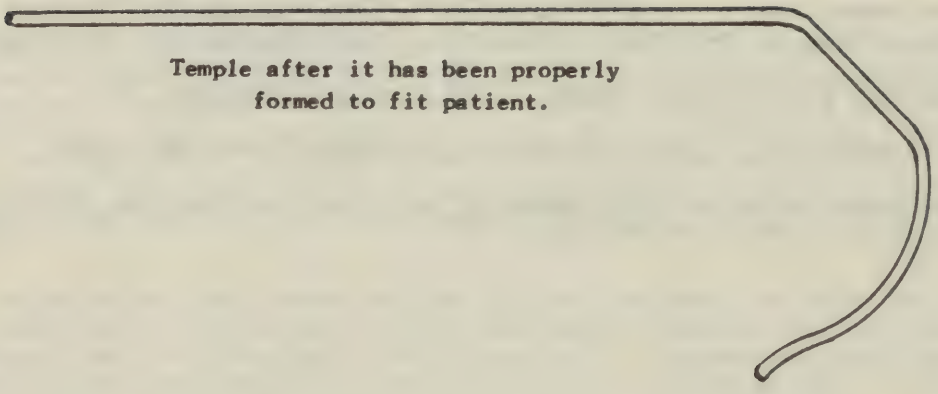
Step number six is the distance of the glasses from the cornea.

Step number seven is the distance of each lens from the nose, and a general check up of all previous adjustments.

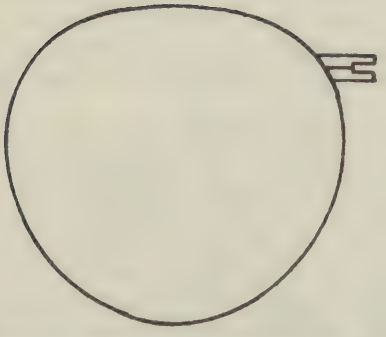
M. S. S. S. Diagram 6-0-107



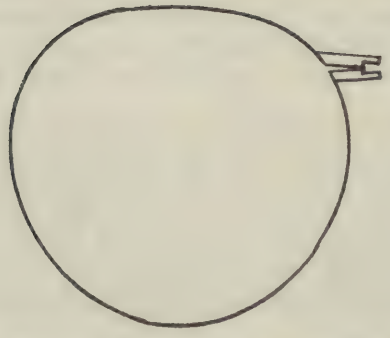
Temple as it comes from stock.



Temple after it has been properly formed to fit patient.

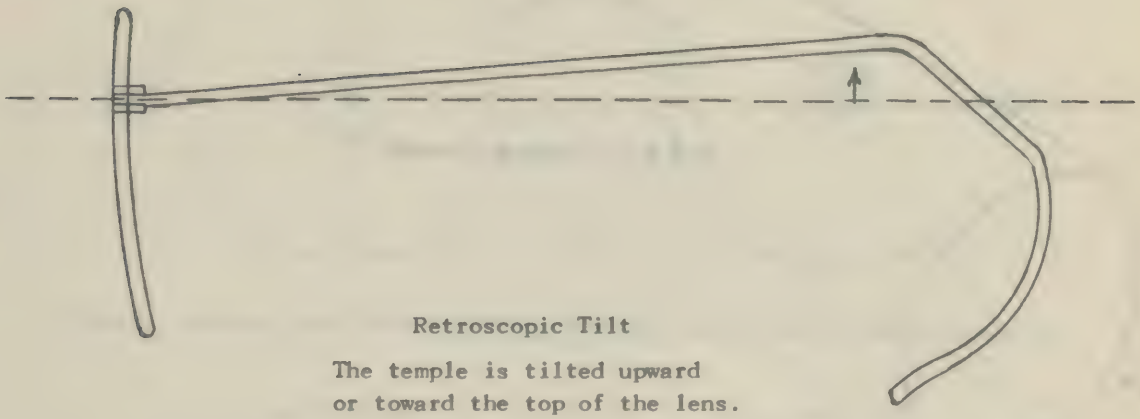


Endpiece closed and parallel.



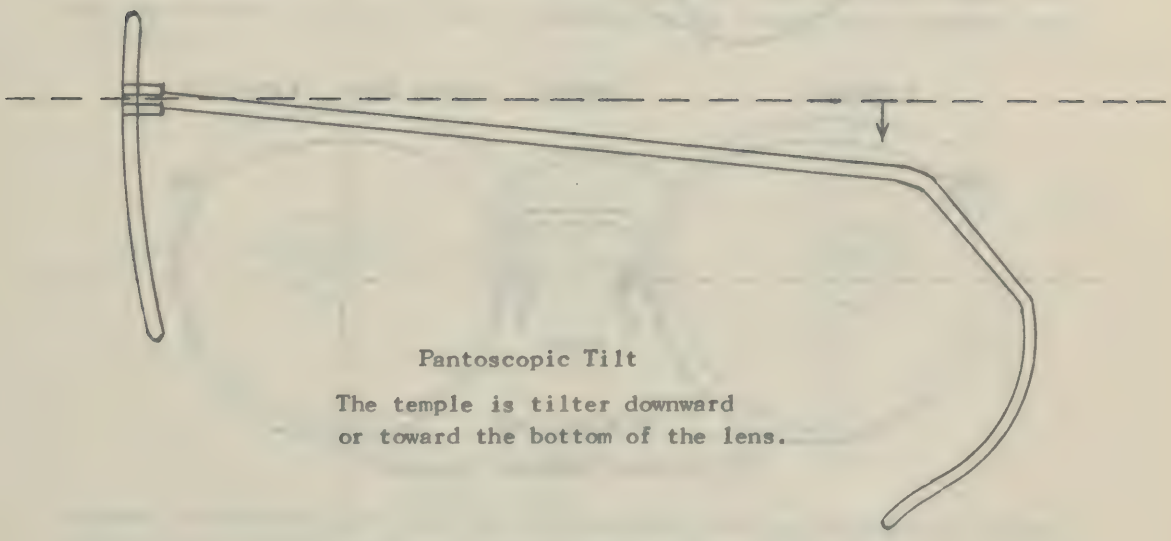
Endpiece not closed. Usually caused by lens being too large.

M.S.S.S. Diagram 7-0-107



Retroscopic Tilt

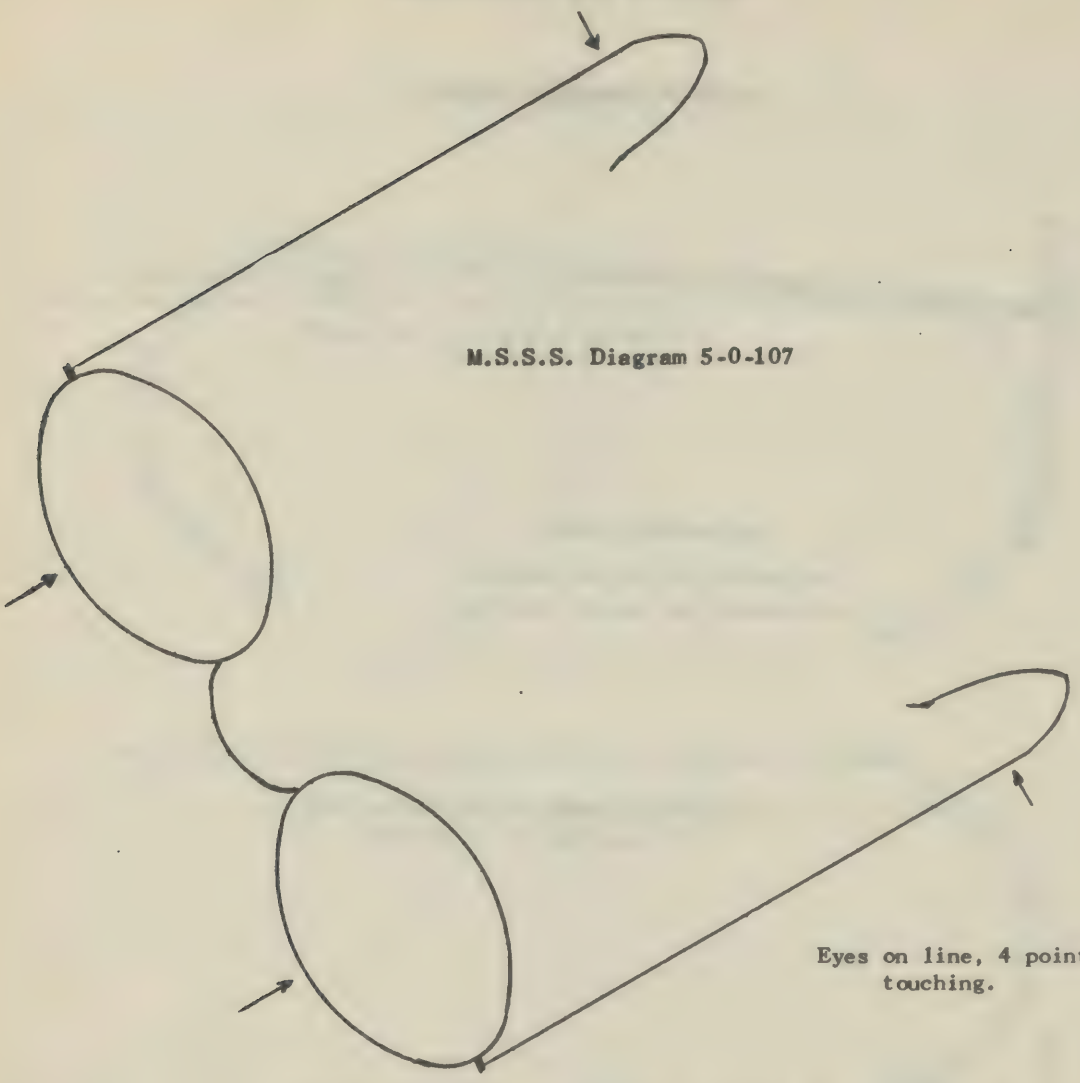
The temple is tilted upward
or toward the top of the lens.



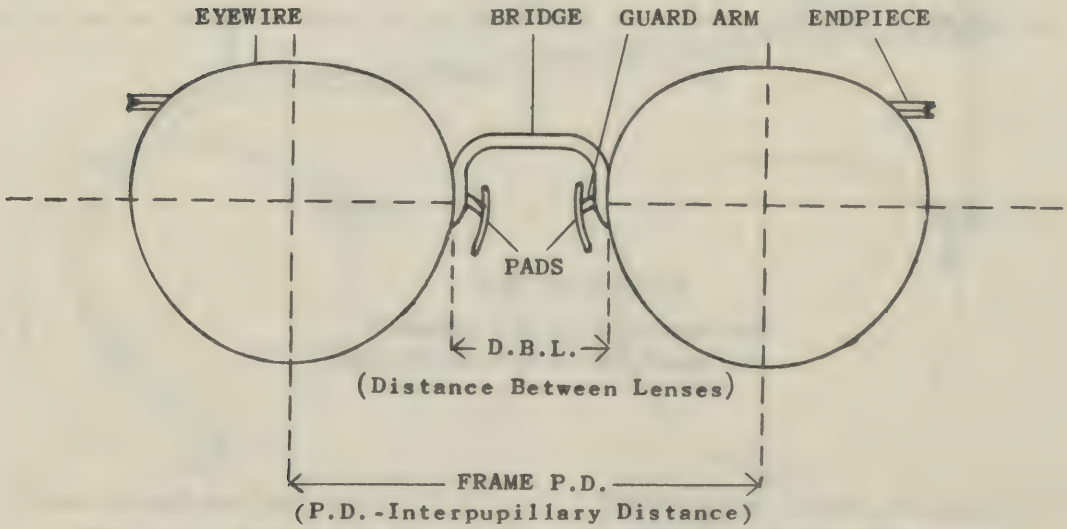
Pantoscopic Tilt

The temple is tilter downward
or toward the bottom of the lens.

M.S.S.S. Diagram 5-0-107

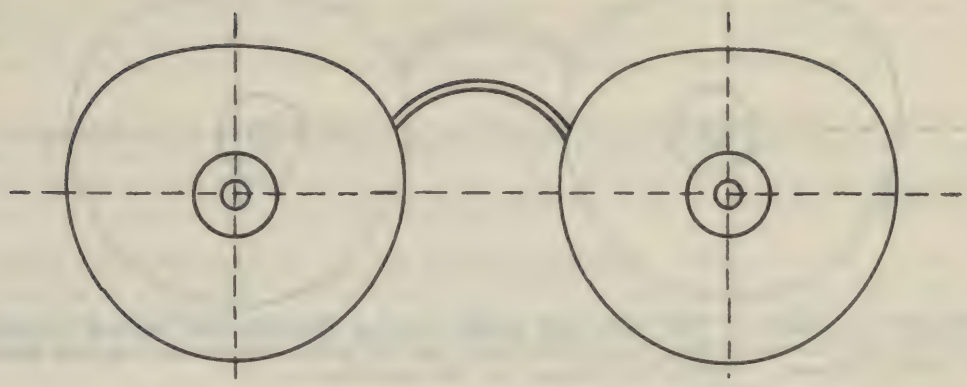


Eyes on line, 4 points touching.

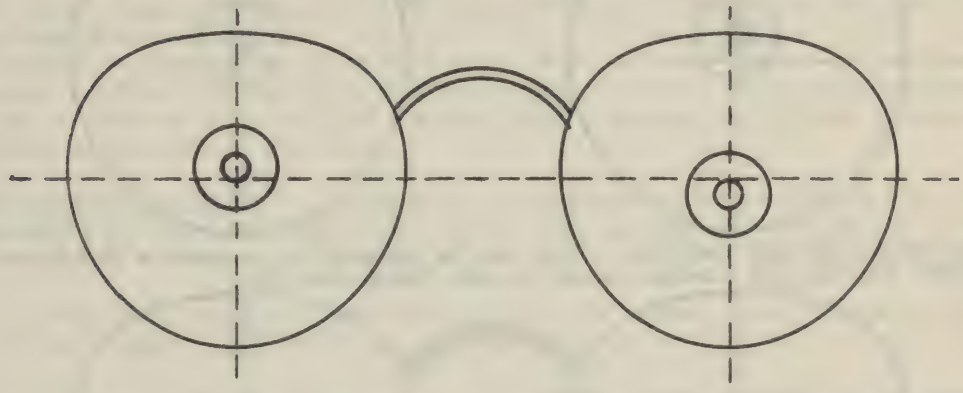



Most easily measured by placing the rule against the inside edge of one eyewire and measuring to the outside of the other eyewire.

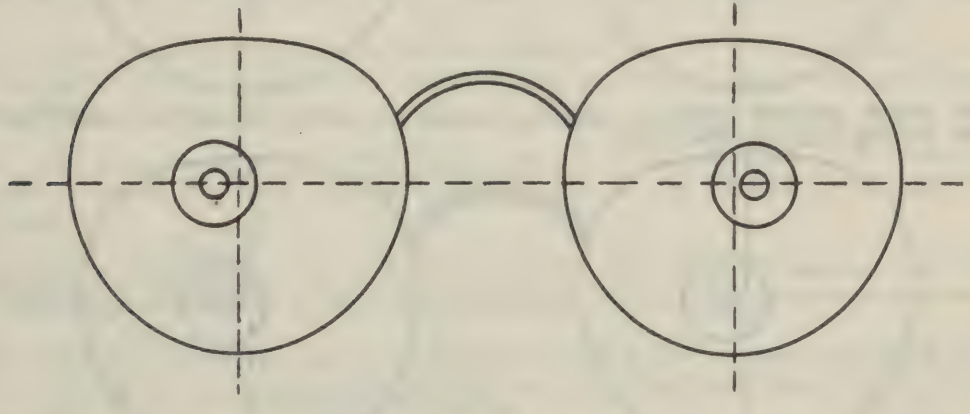
M.S.S.S. Diagram



Glasses showing eyes looking through optical center and aligned properly.

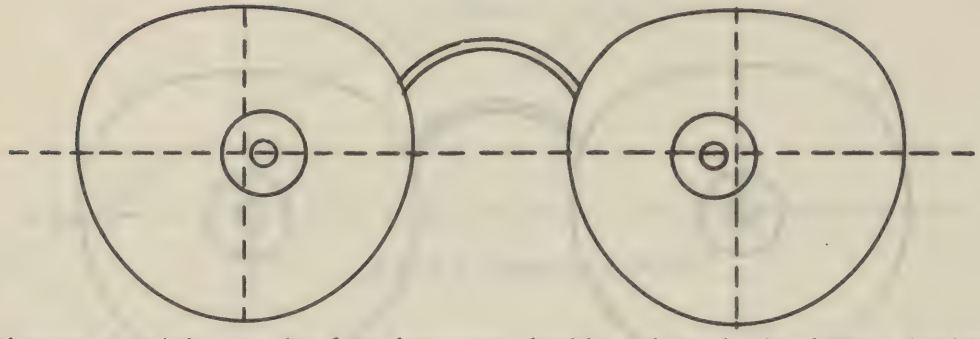


Glasses crooked on face. Showing one eye above the optical center and the other below. This is usually caused by one temple being higher than the other.

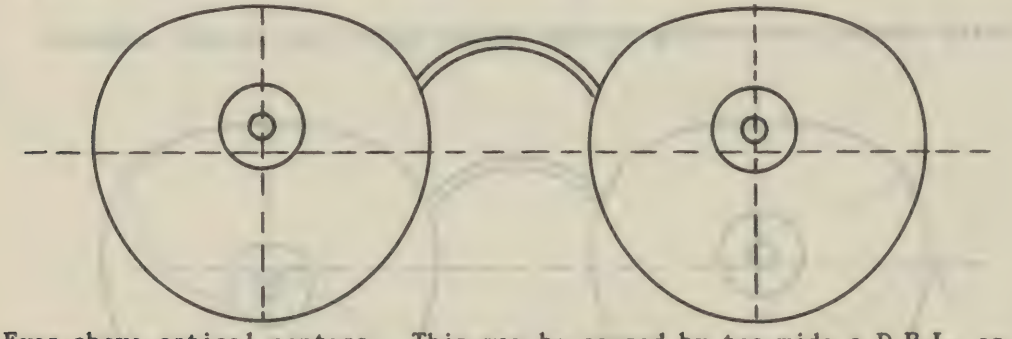


Glasses straight on the face but the eyes are looking through the lenses outside the optical centers causing prism base in plus lenses and base out in minus. Frame too small for the P.D. of the patient.

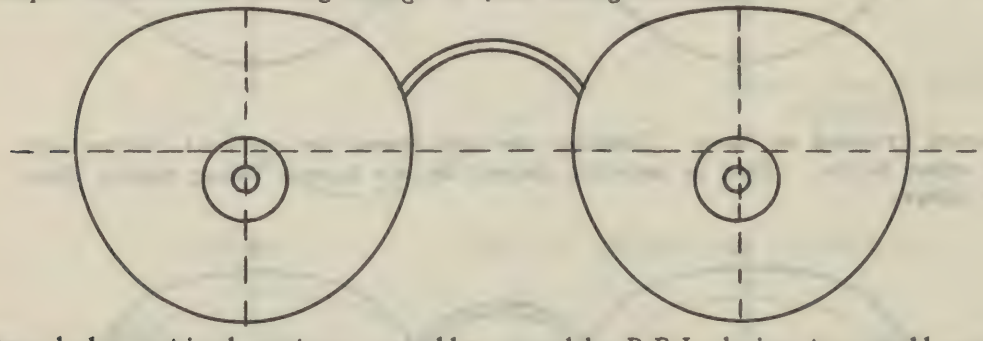
M.S.S.S. Diagram 9-0-107



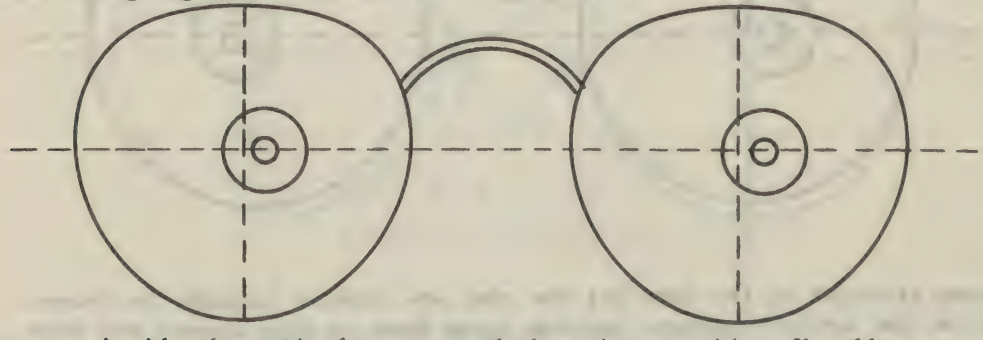
Glasses straight on the face but eyes looking through the lenses inside the optical centers causing prism base out in plus lenses and prism base in minus lenses. Frame too large for the patient.



Eyes above optical centers. This may be caused by too wide a D.B.L. or temple tension not strong enough or pads being too wide.



Eyes below optical centers, usually caused by D.B.L. being too small and pads riding high on the nose.



One eye inside the optical center and the other outside. Usually caused by unusual facial characteristics, remedied by pad adjustment.

## INSTRUCTION MANUAL FOR FITTING EYEGLASS, GAS MASK, M-1

Every pair of M-1 Gas Mask Eyeglasses must be prescribed and fitted carefully. Improper fit may make the mask itself unwearable and every effort should be made to insure the best possible vision and permanently comfortable adjustment.

The instructions and suggestions shown below are intended to facilitate your handling of a completely new visual device and it is recommended that the Manual be retained for ready reference at all times. Follow the procedure exactly and check every pair of eyeglasses for performance in the mask and on the wearer's face.

DESIGN AND CONSTRUCTION OF GAS MASK EYEGLASSES - Refer to Fig. I and familiarize yourself with the various parts and their designations so that it will be easy to follow the instructions. Note that certain portions of the frame have been designated as "sections" for simplicity in referring to them.

Note also that seven types of eyeglasses are available, designated as "Positions." Positions A, B, C, D and E all have 40mm lenses with their centers located in the relative locations indicated by the crosses on the plastic gauge in the fitting case. Positions W and X (34mm eyes) have their centers in the same location as Positions B and D.

Refer to Figs. II and II-a showing a top view of a mask with eyeglasses in place which demonstrates how the smaller lenses provide additional clearance for protruding lashes, brows, and noses.

TO INSERT EYEGLASSES - 1. Snap the headstraps of the mask over the front of the facepiece and fold back the edges of the mask so that you can get at the inside of the eyepieces easily.

2. Grasp the eyeglass frame (Fig. I) at its widest point, between the thumb and first two fingers, and compress it slightly.

3. Press the lower section into the lower inside margin of the eyepiece, making sure that it fits snugly.

4. Shift your grip from the nasal section to the eyewire and press the nasal section into position against the gas mask lens and the margin of the eyepiece.

5. Still retaining your grasp on the temporal section and the eyewire, compress the frame and guide the temporal section into position against the gas mask lens and the margin of the eyepiece.

6. Run your thumb around the frame and, if necessary, press it securely into the groove between the lens and the rubber flange of the eyepiece, so that the lugs grip securely.

TO REMOVE EYEGLASSES - 1. Grasp the eyewire (See Fig. I) between the thumb and first two fingers and move it toward the center of the eyepiece.

2. Continue this motion while gently lifting the eyewire, causing the eyeglass to spring out in this sequence: First, the nasal section; second, the lower section; and, finally, the temporal section.

NOTES ON INSERTION AND REMOVAL OF EYEGLASSES - 1. During these operations, have the wearer hold his mask for you in the most convenient position. Some fitters prefer to work from the upper end of the mask; others, from the lower (mouthpiece) end.

FIG. I

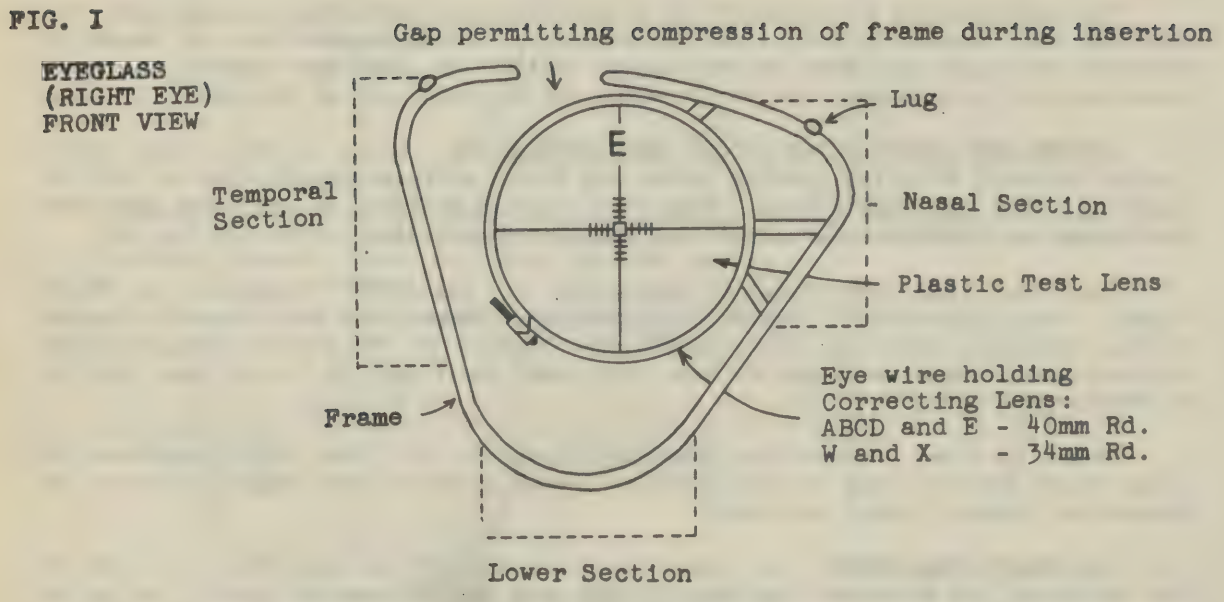
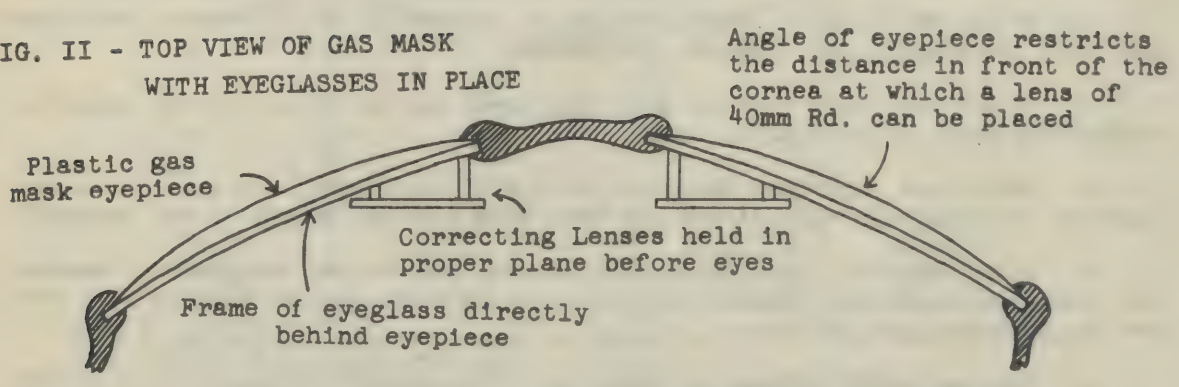



FIG. II - TOP VIEW OF GAS MASK
WITH EYEGLASSES IN PLACE



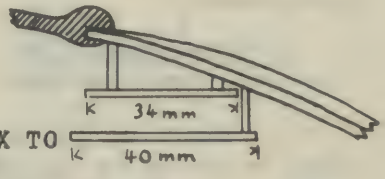
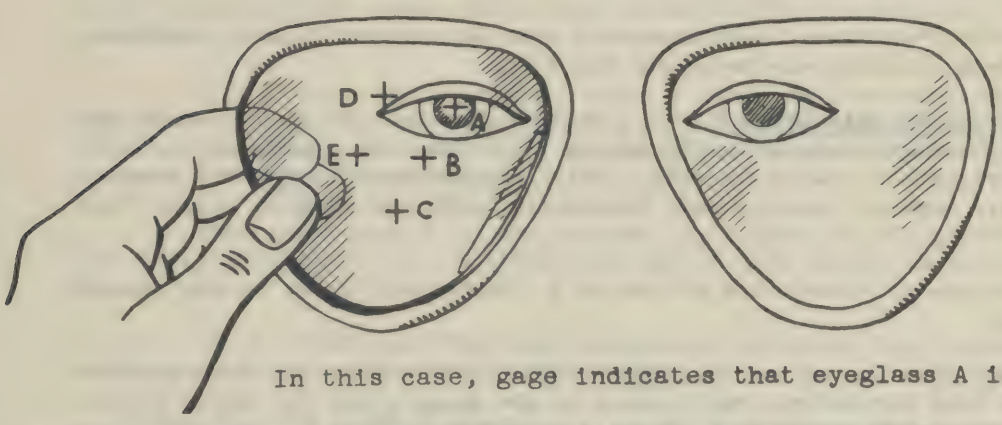



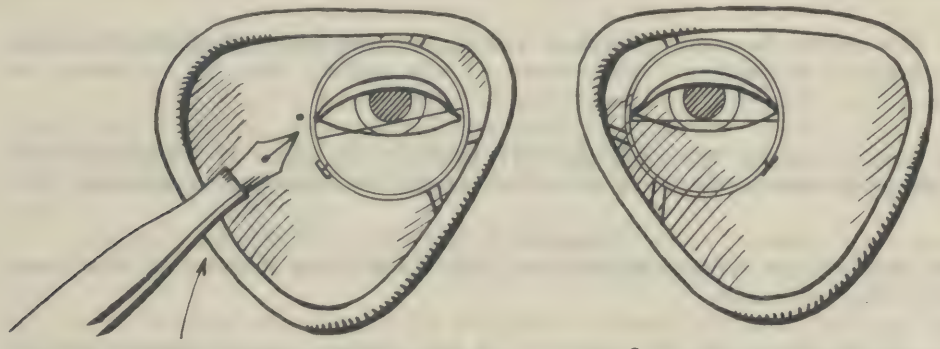

FIG. II-a - THUS: 34mm RD. IN INSERTS W AND X TO ADVANCE THE LENSES WHEN NECESSARY

FIG. III - USING PLASTIC GAGE TO DETERMINE EYEGLASS POSITION REQUIRED




In this case, gage indicates that eyeglass A is required

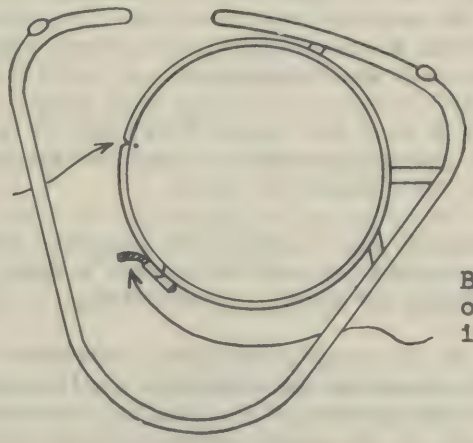
FIG. IV - CHECKING INSERTS FOR PERMANENT USE BY OBSERVING ALIGNMENT OF 180° LINES BEFORE EYES



Ink dot on outer surface of plastic eyepiece shows extent and direction to turn lens in lining up the 180° line

180° line of right lens tips down at temporal extremity. If a cylinder it will be off axis. Left lens is O.K. Both lenses should be lined up in this manner

FIG. V - FINAL STEPS



File mark on eye wire to show where diamond dot should be when lens is at correct axis with mask on face

Bend projecting end of screw to prevent its backing out

2. The frame of the mask is purposely formed slightly larger than the largest eyepiece so that it will fit securely into the groove. Do not hestitate to compress it sufficiently to facilitate insertion.

3. In removing eyeglasses, your hand will move in a circular path, clockwise for the right side and counter-clockwise for the left.

FITTING AND TAKING MEASUREMENTS - 1. Have the wearer put on his mask and adjust it properly, which means primarily seeing to it that the eyepieces are well centered, both horizontally and vertically. This is particularly important because many men wear their masks off-center and, frequently, with one eyepiece higher than the other.

2. Have the wearer direct his vision at a theoretical point on the ground about 75 feet away.

3. Place the plastic measuring gauge in the nasal corner of the eyepiece (See Fig. III) so that the letters and crosses on the gauge cover the wearer's eye. Hold the gauge with thumb and fingers in position shown in Fig. III so that it is perpendicular to the line of sight, not angled back like the gas mask lens--the gauge should be in contact with the lens only at the one corner.

4. Look at the wearer's pupil through the gauge and determine which cross (designated by a letter) is nearest the center of the pupil, that is, closest to the line of sight.

5. Have the wearer remove the mask and fit into it the pair of Eyeglass Test Mounts (A, B, C, D or E) which the test with the gauge indicated will provide the best centering.

6. Have the wearer put his mask back on and direct his vision at the same theoretical point 75 feet distant.

7. Observe, first, how well the centers of the lenses (small squares) correspond with the centers of the pupils. Here, again, it may be necessary to adjust the mask itself to bring the two lenses into the same relative position with respect to the eyes.

a. If positions A or B were tried first and the centers are too close together, the use of Positions D or E is indicated. Conversely, if Positions D or E are tried first and the centers are too far apart, Positions A or B should be used.

b. If Positions B or E are tried first and bring the centers too high, Position C (which provides a pupillary separation about midway between the two) should be tried.

8. Determine next whether the lenses of the eyeglass selected (A, B, C, D or E) will cause uncomfortable pressure against the wearer's face. If so, substitution of one of the small-eye positions (W or X) is indicated.

9. After selection of the proper Position, determine the amount of decentration necessary, if any, by counting the number of small graduations (1mm each) from the center of the lens to the center of the pupil. Decentration can be held to a minimum by (a) adjustment of the mask and (b) proper selection of eyeglasses.

NOTES AND SUGGESTIONS ON FITTING - 1. Remember that most men rarely put on their masks in exactly the same position twice. Try to find the most suitable position in which the eyepieces are well-centered and a gas-tight fit is provided. After prescription lenses have been fitted to the eyeglasses, the man will unconsciously return to that position to get the best vision.

2. The plastic measuring gauge will be found particularly helpful in determining the most suitable vertical centering and should be used consistently to expedite fitting. Remember, however, that it should not lay back against the eyepiece lens but should touch only the corner.

3. Hold decentration to the minimum. The crosses on the plastic gauge indicate the variety of Positions available and one of them should be fairly well centered on any wearer.

4. If two different Positions seem to be required, such as an A and a D, the adjustment of the mask itself is incorrect.

5. Use the smaller eye sizes (W and X) only when absolutely necessary. The field of vision through that type is rather restricted and it should be ordered only when the 40mm eyes cannot be fitted.

TO ORDER EYEGLASSES - 1. Show the lens focus.

2. Show the decentration in millimeters. It will not suffice to show the pupillary distance, because the distance between the lenses is not constant.

3. Indicate the Position (A, B, C, D, E, W or X) which is required.

TO FIT AND CHECK COMPLETED EYEGLASSES - 1. Insert the eyeglasses into the mask, being careful to avoid erasing the inked ($180^{o}$) lines on the lenses.

2. Direct the wearer to put on his mask and look at the theoretical point 75 feet distant.

3. Determine whether the inked lines on the lenses are in horizontal alignment before the wearer's eyes.

4. If not, check the adjustment of the mask.

5. If either or both of the inked lines are not now horizontal, put an ink or wax crayon mark on the outer surface of the gas mask eyepiece at the point where the temporal extremity of the inked line should be located. (Fig. IV).

6. Remove the mask and eyeglasses (one at a time).

7. Back off the screw in the eyeglass and turn the lens in the amount which seems to be indicated.

8. Tighten the screw again and then back it off one-half turn to relieve extreme pressure.

9. Replace the eyeglass in the mask and check the temporal extremity of the inked line with the mark previously placed on the eyepiece. If not in alignment, remove the mask and eyeglass and repeat operations 6, 7, and 8.

10. Check the 180° lines with the mask on the wearer's face.

11. When both inked lines are horizontal and the mask is gas-tight, remove the mask and the eyeglasses from the mask.

12. Insert the blade of your screw driver between the projecting end of the screw and the eyewire and bend the screw up at about 45° angle (Fig. V). This will prevent the screw from backing out and leaving the lens loose.

13. With a sharp-edged file or other suitable tool, cut a mark in the eyewire at the temporal end of the inked line on the lens. This will serve as a reference point so that, if the lens should be turned in the eyewire, it can be properly re-set. The diamond mark which has been ground on the lens can be lined up with the file cut on the eyewire.

14. Clean the lenses and then very carefully show the wearer how to insert and remove the eyeglasses. Point out that they must be removed periodically for cleaning and the simple technique must be acquired to eliminate the possibility of bending the eyeglasses and permanently destroying the alignment of the lenses before the eyes. Point out that the eyeglasses can be removed easily without the aid of any implement which might damage the mask.

## APPENDIX PERTAINING TO DISTRIBUTION OF EYEGLASS GAS MASK M-1 IN OVERSEAS THEATRES OF OPERATION

1. The distribution of the eyeglass gas mask M-1 in overseas theatres will probably be accomplished through the same sources, through which ordinary spectacles for visual correction are provided; namely, eye clinics of hospital installations, Optical Repair and Replacement Sections of Medical Depot Companies and through the newly devised Optical Repair Units, Portable, as soon as the latter becomes available in the field.

2. It is contemplated that in supplying these gas mask eyeglasses to the various theatres, the frames will be accompanied by a stock of lenses pre-edged to 40mm eye size, round. These lenses will be in the foci range determined from an analysis of military prescriptions heretofore filled and should take care of the great majority of personnel requiring this correction. Pre-edged lenses are not being furnished, however, for the frames for positions W and X which have the smaller 34mm eye because of the impracticability of having to determine the quantity of these which will be required. It is anticipated, however, that these will represent a very small percentage of the total, and these, as well as odd foci prescriptions now provided for in the stock of edged lenses, will have to be taken care of in the same manner as other prescriptions for spectacles, that is, through optical repair and replacement facilities which have been established in the several theatres.

3. The following information and instructions are for the guidance of those who may be furnishing this correction in the field away from regularly established optical repair installations:

All the edged cylindrical lenses included in the stock supplied are ground and marked as "plus cylinders." Therefore, if the prescription calls for a "minus cylinder," that is, with a minus sign before the cylinder power, it must be transposed to plus cylinder form before the lens can be selected from stock and "laid out" for insertion in the eyeglass.

The simplest rule for transposition is this: Combine algebraically the sphere and cylinder powers to obtain the new sphere power; change the sign, but not the power, of the cylinder; and add 90° to the axis if it is 90° or less, or substract 90° if the axis is more than 90°.

Example #1. -0.50 -0.50 x 90
Transposed -1.00 +0.50 x 180

Note: When combining two minus powers, add the powers and retain the sign.

Example #2. +1.00 -0.50 x 45
Transposed +0.50 +0.50 x 135

Note: When combining a minus power with a plus power, substract the smaller from the larger and retain the sign of the larger.
Similarly, +1.00 -1.50 x 45 = -0.50 +1.50 x 135

Example #3. -0.50 x 145
Transposed -0.50 +0.50 x 55

Note: In this case, the minus cylinder is combined with zero spherical power, which might be called a "plus power", and the rule in example #2 applies.

Example #4. +0.50 -0.50 x 15
Transposed + 0.50 x 105

Note: In this case, the minus and plus powers cancel out, leaving no spherical power.

After transposing the prescription (if necessary), select from stock the plus cylinder lens required and note that it bears three ink dots which indicate the position of the cylinder axis. Then, with the bead in position to look directly down on the protractor:

1. Place the lens, convex surface down, on the protractor with the center ink dot at the intersection of the two black lines at the center of the protractor.

2. Keeping the center dot in that position, rotate the lens until the two outer ink dots are directly above the required axis line which is designated by the black figures.

3. Holding the lens securely in that position, draw the 180° line with ink or wax pencil across the lens directly over the horizontal line of the protractor.

Note: If the axis is 180°, the line will be superimposed on the three ink dots; if 90°, at right angles to the dots.

4. Remove the lens and cut a mark with a sharp-cornered file or other suitable tool on the edge of the lens at one end of the 180° line. This will serve as a reference point after the line has been erased.

5. Without erasing the 180 line, insert the lens into the eyeglass and turn up the screw only enough to hold the lens without preventing its being rotated.

6. Rotate the lens in the eye wire so that the end of the 180° line which has not been cut (Par. 4) is located at the middle bracket connecting the eye wire to the frame. (The middle bracket is the only one which is soldered to the frame, the other two being looped around it).

7. Tighten the screw and then back it off one-half turn to relieve excessive pressure.

8. Proceed with fitting as indicated in the Instruction Manual.

## METHOD OF OBTAINING THE DISTANCE FROM THE APEX OF THE CORNEA TO THE VERTEX OF THE LENS (VERTEX DISTANCE)

The distance from the apex of the cornea to the vertex of the lens is most easily found by means of the Wessely Keratometer or a similiar instrument. This instrument will not be available in the field but by using the P.D. rule, a depth of curve chart, and being very careful, an accurate measurement may be obtained.

Knowing the distance from the apex of the cornea to the vertex of the lens, you can accurately determine the resultant power of any lens placed at any distance in front of the eye by means of the chart showing the resultant powers of a lens as the distance of the lens is varied. This will prove valuable when the necessity for substitution arises. The lens power desired and the distance of the lens from the eye may be determined from Chart 1-0-107. This distance is known as the Vertex Distance.

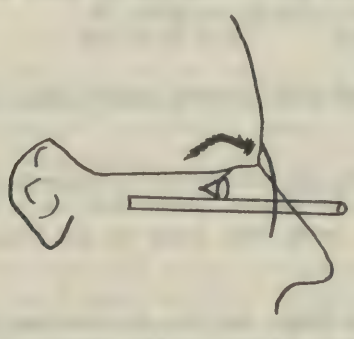


Fig. 1

Seat the patient so that you are facing the right side of his head. With the P.D. rule in the right hand place it along his temple in such a manner that the index mark of the rule is toward the ear, the 6 cm. mark about even with the apex of the cornea and the rule resting against the patient's temple and the temporal edge of the eyewire of his glasses. (See Fig. 1). Place your eye 16 inches from the rule and line up the nasal edge of the eyewire and the temporal edge of the eyewire as you would the sights of a rifle. (See Fig. 2).

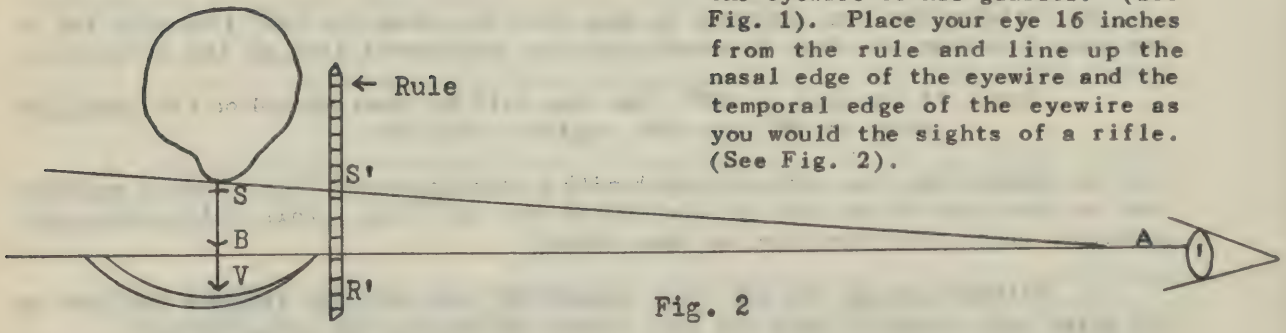



Fig. 2

Measure the apparent distance from the apex of the cornea to the eyewire of the glasses by sighting the corneal apex and eyewire positions on the rule. This measurement is not the true distance. (See Fig. 2). The base of the triangle A R' S', the distance S' R', which is actually measured is not as large as the base of the triangle A B S, the distance B S, which is the actual distance from the apex of the cornea to the eyewire of the glasses. This difference has been calculated and made into a table. (See Fig. 3).

By taking the corrected measurements from the table and adding the depth of curve V (See Fig. 2) of the lens found in the depth of curve chart MSSS 2-0-112 the true distance from the apex of the cornea to the vertex of the lens may be calculated.

The distance from the observers eye to the rule must be 16 inches. The patients line of vision must be at right angles to the vision of the observer. If these two principles are not followed an error will be introduced and the whole measurement worthless.

This measurement is subject to a great many errors. The technique must be learned thoroughly and rigidly adhered to. The final calculation will be no more accurate than the measurement.

Fig. 3

| Apparent Distance - 6 mm. | 7 mm. | 8 mm. | 9 mm. | 10 mm. | 11 mm. | 12 mm. | 13 mm. |
|---|---|---|---|---|---|---|---|
| Actual Distance - 6.4 mm. | 7.43mm. | 8.5mm. | 9.56mm. | 10.62mm. | 11.69mm. | 12.74mm. | 13.81mm. |

| Apparent Distance - 14 mm. | 15 mm. | 16 mm. | 17 mm. | 18 mm. | |
|---|---|---|---|---|---|
| Actual Distance - 14.88 mm. | 15.93 mm. | 17.00 mm. | 18.06 mm. | 19.12 mm. | |

M.S.S.S. Chart I-0-107

## CHANGE OF EFFECTIVE POWER OF A LENS AS THE DISTANCE FROM THE EYE IS VARIED.

Distance, in mm., from the cornea to the vertex of the lens.

| Sphere Power | 10 mm. | 11 mm. | 12 mm. | 13.5mm. | 14 mm. | 15 mm. | 16 mm. | 17 mm. | 18 mm. | 19 mm. | 20 mm. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.00 | 0.99 | 0.998 | 0.999 | 1.00 | 1.001 | 1.002 | 1.003 | 1.004 | 1.01 | 1.012 | 1.013 |
| 1.50 | 1.49 | 1.495 | 1.498 | 1.50 | 1.502 | 1.504 | 1.506 | 1.509 | 1.522 | 1.524 | 1.525 |
| 2.00 | 1.988 | 1.99 | 1.995 | 2.00 | 2.005 | 2.01 | 2.015 | 2.02 | 2.025 | 2.028 | 2.03 |
| 2.50 | 2.48 | 2.486 | 2.492 | 2.50 | 2.505 | 2.511 | 2.517 | 2.523 | 2.528 | 2.534 | 2.54 |
| 3.00 | 2.946 | 2.966 | 2.986 | 3.00 | 3.01 | 3.02 | 3.03 | 3.04 | 3.05 | 3.06 | 3.07 |
| 3.50 | 3.47 | 3.48 | 3.49 | 3.50 | 3.513 | 3.526 | 3.539 | 3.552 | 3.565 | 3.578 | 3.591 |
| 4.00 | 3.95 | 3.966 | 3.982 | 4.00 | 4.02 | 4.04 | 4.06 | 4.08 | 4.10 | 4.12 | 4.14 |
| 4.50 | 4.44 | 4.46 | 4.48 | 4.50 | 4.52 | 4.54 | 4.56 | 4.58 | 4.60 | 4.62 | 4.64 |
| 5.00 | 4.92 | 4.946 | 4.952 | 5.00 | 5.03 | 5.06 | 5.09 | 5.12 | 5.16 | 5.19 | 5.23 |
| 5.50 | 5.45 | 5.466 | 5.82 | 5.50 | 5.54 | 5.58 | 5.62 | 5.66 | 5.70 | 5.75 | 5.78 |
| 6.00 | 5.94 | 5.96 | 5.98 | 6.00 | 6.047 | 6.094 | 6.14 | 6.188 | 6.235 | 6.282 | 6.329 |
| 6.50 | 5.36 | 6.406 | 6.446 | 6.50 | 6.55 | 6.60 | 6.65 | 6.70 | 6.75 | 6.80 | 6.85 |
| 7.00 | 6.82 | 6.88 | 6.94 | 7.00 | 7.05 | 7.10 | 7.15 | 7.20 | 7.25 | 7.30 | 7.35 |
| 7.50 | 7.35 | 7.40 | 7.45 | 7.50 | 7.56 | 7.62 | 7.68 | 7.74 | 7.80 | 7.86 | 7.92 |
| 8.00 | 7.82 | 7.88 | 7.94 | 8.00 | 8.08 | 8.16 | 8.24 | 8.32 | 8.40 | 8.48 | 8.56 |
| 8.50 | 8.33 | 8.396 | 8.45 | 8.50 | 8.584 | 8.668 | 8.752 | 8.836 | 8.92 | 9.00 | 9.088 |
| 9.00 | 8.75 | 8.83 | 8.91 | 9.00 | 9.087 | 9.174 | 9.261 | 9.348 | 9.435 | 9.552 | 9.61 |
| 10.00 | 9.70 | 9.80 | 9.90 | 10.00 | 10.107 | 10.214 | 10.321 | 10.428 | 10.535 | 10.642 | 10.75 |
| 11.00 | 10.75 | 10.83 | 10.91 | 11.00 | 11.15 | 11.30 | 11.45 | 11.60 | 11.75 | 11.90 | 12.05 |
| 12.00 | 11.67 | 11.78 | 11.89 | 12.00 | 12.22 | 12.44 | 12.66 | 12.88 | 13.00 | 13.25 | 13.50 |

# SECTION IX

# STOCK CONTROL

# STOCK CONTROL

There is a tendency to attach too little importance to the proper control of stock, with the result that a unit or installation cannot function to its peak of efficiency.

With reference to a Base or Mobile Optical Repair Unit it can be readily visualized that excessive time would be consumed by the unnecessary surfacing of semi-finished blanks that normally would be stocked as finished lenses. The maintenance of insufficient and improper stock levels in a Portable Unit will increase the number or prescriptions that cannot be processed and thereby reduce its effectiveness in the servicing of field troops.

The stock of lenses contained in each unit will have sufficient foci range to permit the processing of approximately 95% of all prescriptions and in order to maintain this percentage it will be necessary to keep the stock at the proper level.

The stock of a Mobile Unit will approximate 18,000 lenses, 6,000 fronts, 7,500 pair of temples and 1200 spectacle cases. The Portable Unit will contain 2400 lenses, 600 fronts, 750 pairs of temples together with a nominal quantity of gas mask inserts and slipovers.

The fronts and temples are contained in six cabinets. The fronts are arranged in eyesize order. Starting with the top lefthand drawer; 40 mm. eye with 20 mm. bridge is first, followed by 40 mm. eye with 22 mm. bridge, 40 mm. eye with 24 mm. bridge, 40 mm. eye with 26 mm. bridge, 42 mm. eye with 20 mm. bridge, and so on to 46 mm. eye with 26 mm. bridge.

The temples start with 5½ inch, followed by 6, 6½ and 7 inches respectively.

The lens stock is contained in eight cabinets. Starting with the upper lefthand drawer will be convex meniscus in numerical order of strength, namely + 0.25, + 0.50, + 0.75, etc., followed by concave meniscus in the same order. These will be followed by plano plus cylinders arranged in the same manner: + 0.25, + 0.50, + 0.75, etc.

The remaining cabinets will be taken up with compounds. The sequence for the sphero-cylinders is, minus on plus, headed by: -0.25 + 0.25; -0.50 + 0.25; -0.75 + 0.25, etc. These will be followed by plus on plus in the same sequence.

The fronts are arranged by the smallest eyesize broken down into bridge sizes followed by the next larger eyesize broken down into bridge size, etc. The temples are arranged according to length starting with the smaller.

The sequence for meniscus lenses is, convex meniscus broken down in to foci starting with the smallest followed by concave meniscus broken down the same way; plano cylinders in the same manner.

The compounds are arranged minus on plus first and plus on plus second. Each is divided into foci by cylindrical power and then spherical power. It can be readily seen that while the various repair units are sufficiently stocked it will be essential that consumed stock be replaced in the proper quantity at the proper time.

The first stop in any stock control system is to make an accurate physical count, and enter the results at the head of the stock record cards in red ink. This gives a basis for all future entries and insures an accurate record when used in combination with a daily running inventory. The next step is to set up a maximum

and a minimum figure on each item. This insures a working stock on hand at all times. The system explained below is only one system, the Commanding Officer of your unit will set up his own system, but by familiarizing yourself with this basic method any other will differ only in procedure.

In each cabinet, at the rear of each eye and bridge size, temple length, or foci, is an index card. On one side is given the description, catalog number (if any), eye and bridge size, temple length, or foci as the case may be, the maximum and minimum number to be carried in stock. A minimum should be established for each item based on twice the replacement time. In other words, if the location of the unit is such that it requires two weeks to get requisitioned stock, then the minimum should be four weeks disbursement.

As soon as the minimum for each item has been established then that quantity, the minimum, should be tied up or marked in such a way that it can be positively identified.

## REPLENISHING

The reorder point for each item will be established by the Unit Commander, this may or may not be the minimum. The depot from which the unit is to receive its stock will designate a regular reorder date, this should be adhered to except in case of emergency.

Requisitions for replacements will be made on War Department forms provided for this purpose (see attached forms). Use a separate sheet for plus on plus, one for minus on plus, and one for temples and fronts. Concave meniscus, convex meniscus, and plano-cylinders have a separate heading on the compound sheet.

When stock has been used down to the reorder point the index card for that particular item should be taken out and given to the clerk. He will note it on his order form and return it to its place with the side marked ORDERED facing out.

When stock is received, and any of the minimum has been used, fill out the minimum and again ear mark that quantity. Place the rest of the stock in the working section. Turn the card around and cross off the date the stock was ordered.

If stock has been ordered and you are forced to use the minimum to exhaustion, the card should be taken out again and an emergency order placed for the minimum amount.

When requisitioning, especially machinery, tools, etc., be sure and give all possible information. Include make, model, serial number, size, voltage, cycle, and any other description that may be helpful. This will facilitate replacements and eliminate correspondence with the depot.

The importance of keeping a running inventory cannot be minimized. This gives an accurate daily picture of the stock status, facilitates accurate ordering and reduces the possibility of being out of much needed stock at a critical moment.

There are many methods of maintaining a running inventory. The Commanding Officer of the unit is at liberty to set up any system that he may desire.

The method used here at the school is one method, and will serve to guide you later. Any method set up will be essentially the same, varying only in procedure.

A 3" by 5" card is made out for each foci of lens, each eye and bridge size of front, and each length of temple. These have the necessary information for reordering on them as well as the maximum and minimum number and the reorder point. The card is divided into three columns. The first for the date, the second for any pertinent information such as voucher numbers, amount used, amount received, breakage etc., the third column shows the amount on hand. These cards are posted each day thus keeping an accurate picture of the stock status.

Each quarter, or as the Commanding Officer may designate, a complete physical inventory is taken. The amount of the physical count is entered in the "amount on hand column" in red ink, and the notation made in the second column "As per Inventory" also in red ink.

By using this system the stock clerk can go through the cards before the designated order date and complete his order according to the present demand and future needs.

The following is an extraction from "The Procedure for the Operation of the Mobile, Base and Portable Optical Repair Units" as issued by the Office of the Surgeon General.

REQUISITIONING OF FRAMES AND LENSES - Previously, The Surgeon General's Office advised the various mobile and base units that an automatic supply of frames and lenses to cover estimated requirements for three month periods would be established. However, this automatic flow program has been disapproved and under the existing policy, requisitions must be originated in the various theaters in the usual manner for these ophthalmic supplies. Inasmuch as a procurement program has been set up for frames and lenses to cover oversea requirements, it is necessary in the requisitioning of such ophthalmic supplies that frame sizes and lens foci be requisitioned only in such powers as have been placed in procurement and stocked. Requisitions should be placed for ophthalmic supplies covering a three month period in order that procurement programs may be kept in line with the stocks furnished, and it is essential that requisitions be made on this basis. Each requisition shall have attached a brief summary of the number of complete replacement jobs. Overstocking of ophthalmic supplies on the part of mobile and base units can seriously interfere with the stock control, and may prove to be a serious handicap in the event the unit is moved fron one territory to another.

In order that realistic needs can be requisitioned, some practicable form of stock control is recommended in order that more or less accurate requirements can be listed. This is necessary in view of the fact that productive facilities in this country are being heavily taxed, and accurate planning of the procurement program must be effected in order that requisitions placed by the mobile and base control repair units may be filled promptly. With stockpile quantities of expendable ophthalmic supplies available for oversea maintenance, there is no need for requisitioning supplies in excess of actual requirements, and adherence to the recommended procedures will minimize delays and procurement difficulties.

Attached hereto is a chart of the frames and lenses presently available in stock for which a procurement program has been initiated. Again, it is emphasized that the requisitioning of ophthalmic supplies should be within this range of frames and foci of lenses.

Also attached hereto is list showing the various stocks placed in procurement of surfacing supplies and the range of rough blanks and semi-finished meniscus.

SUMMARY - It is anticipated that the officers in charge of optical repair units will recognize the problems involved in the procurement and distribution of ophthalmic supplies in overseas theaters, and that they will cooperate to the fullest extent in the program described herein. Any reasonable and constructive suggestions for improvement of the program will receive every consideration, and this office urges the officers in charge of optical units to submit frequent report of their problems. These should be submitted through channels to the Office of The Surgeon General and the practice of some officers whereby their needs and criticisms are directed to acquaintances in the service or former associates in the optical industry or profession is to be discouraged.

## FRONTS AND TEMPLES

The following sizes of fronts and temples have been procured and are being carried in stock:

Fronts (each) - -

| | | | |
|---|---|---|---|
| 40 x 18 | 42 x 20 | 44 x 20 | 46 x 22 |
| 40 x 20 | 42 x 22 | 44 x 22 | 46 x 24 |
| 40 x 22 | 42 x 24 | 44 x 24 | 46 x 26 |
| 40 x 24 | 42 x 26 | 44 x 26 | |
| 40 x 26 | | | |

Temples (pair) - -

3½", 4", 4½", 5"

## ROUGH BLANKS AND SEMI-FINISHED LENSES

The following rough blanks and semi-finished lenses have been procured and are being carried in stock:

1. Molded blanks (6 base curve, 6 mm. thick)
2. +6 base curve semi-finished meniscus, 6 mm. thick
3. -6 base curve semi-finished meniscus, 6 mm. thick
4. Semi-finished toric cylinders, 6 base curve, 6 mm. thick, as follows:

| | | |
|---|---|---|
| + 0.25 | + 2.50 | + 4.75 |
| + 0.50 | + 2.75 | + 5.00 |
| + 0.75 | + 3.00 | + 5.50 |
| + 1.00 | + 3.25 | + 6.00 |
| + 1.25 | + 3.50 | + 6.50 |
| + 1.50 | + 3.75 | + 7.00 |
| + 1.75 | + 4.00 | + 7.50 |
| + 2.00 | + 4.25 | + 8.00 |
| + 2.25 | + 4.50 | |

## STOCK CONTROL

### LENSES

The following foci of lenses as indicated by the letter "X" have been procured and are being carried in stock:

| | + SPHERES | + SPHERES | + CYLINDERS |
|---|---|---|---|
| Plano | X | | |
| .25 | | X | |
| .50 | X | X | X |
| .75 | X | X | X |
| 1.00 | X | X | X |
| 1.25 | X | X | X |
| 1.50 | X | X | X |
| 1.75 | X | X | X |
| 2.00 | X | X | X |
| 2.25 | X | X | X |
| 2.50 | X | X | X |
| 2.75 | X | X | X |
| 3.00 | X | X | X |
| 3.25 | X | X | X |
| 3.50 | X | X | X |
| 3.75 | X | X | X |
| 4.00 | X | X | X |
| 4.25 | X | X | X |
| 4.50 | X | X | X |
| 4.75 | X | X | X |
| 5.00 | X | X | X |
| 5.50 | X | X | X |
| 6.00 | X | X | X |
| 6.50 | X | X | |
| 7.00 | X | X | |
| 7.50 | X | X | |
| 8.00 | | X | |

## + ON + SPHERO-CYLINDERS

| | .25 | .50 | .75 | 1.00 | 1.25 | 1.50 | 1.75 | 2.00 | 2.25 | 2.50 | 3.00 | 3.50 | 4.00 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .25 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| .50 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| .75 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 1.00 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 1.25 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 1.50 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 1.75 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 2.00 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 2.25 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 2.50 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 2.75 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 3.00 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 3.25 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 3.50 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 3.75 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 4.00 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 4.25 | X | X | X | X | X | X | X | X | X | X | | | |
| 4.50 | X | X | X | X | X | X | X | X | X | X | X | X | |
| 4.75 | X | X | X | X | X | X | X | X | | | | | |
| 5.00 | X | X | X | X | X | X | X | X | | X | X | | |
| 5.50 | | X | | X | | X | | X | | X | | | |
| 6.00 | | X | | X | | X | | X | | | | | |
| 7.00 | | X | | X | | | | | | | | | |

– ON + SPHERO-CYLINDERS

| | .25 | .50 | .75 | 1.00 | 1.25 | 1.50 | 1.75 | 2.00 | 2.25 | 2.50 | 2.75 | 3.00 | 3.25 | 3.50 | 3.75 | 4.00 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .25 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| .50 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| .75 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 1.00 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 1.25 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 1.50 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 1.75 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 2.00 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 2.25 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 2.50 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 2.75 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 3.00 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 3.25 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 3.50 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 3.75 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 4.00 | X | X | X | X | X | X | X | X | X | X | X | X | X | X |  | X |
| 4.25 | X | X | X | X | X | X | X | X | X | X | X | X |  | X |  | X |
| 4.50 | X | X | X | X | X | X | X | X |  | X | X | X |  | X |  | X |
| 4.75 | X | X | X | X | X | X | X | X |  | X | X | X |  | X |  |  |
| 5.00 | X | X | X | X | X | X | X | X |  | X | X | X |  | X |  | X |
| 5.50 |  |  |  | X |  | X |  | X |  | X |  | X |  | X |  | X |
| 6.00 |  |  |  | X |  | X |  | X |  | X |  | X |  | X |  | X |
| 7.00 |  |  |  | X |  | X |  | X |  | X |  | X |  | X |  | X |
| 8.00 |  |  |  | X |  | X |  | X |  | X |  | X |  | X |  | X |

FRAME REQUISITION SHEET

FRONTS FOR H3878 FRAME

ALL QUANTITIES IN SINGLES

| EYE SIZE | BRIDGE SIZES | | | | | |
|---|---|---|---|---|---|---|
| | 20 MM | 22 MM | 24 MM | 26 MM | | |
| | | | | | | |
| 40 | | | | | | |
| 42 | | | | | | |
| 44 | | | | | | |
| 46 | | | | | | |
| | | | | | | |

TEMPLES FOR ABOVE
ALL QUANTITIES IN SINGLES

| | | | | | | |
|---|---|---|---|---|---|---|
| | | 3 1/2" | 4" | 4 1/2" | 5" | |
| RIGHTS | | | | | | |
| LEFTS | | | | | | |

DATE

UNIT

BY

LENS REQUISITION SHEET
50 MM FINISHED
ALL QUANTITIES IN PAIRS

| | CYLINDRICAL | | | | | | | | | CX MEN. | CC MEN. | PL CYL. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | PLANO | | | |
| | .25 | .37 | .75 | 1.00 | 1.25 | 1.50 | 1.75 | 2.00 | | | | |
| SPHERICAL .25 | | | | | | | | | | | | |
| .37 | | | | | | | | | | | | |
| .50 | | | | | | | | | | | | |
| .62 | | | | | | | | | | | | |
| .75 | | | | | | | | | | | | |
| 1.00 | | | | | | | | | | | | |
| 1.25 | | | | | | | | | | | | |
| 1.50 | | | | | | | | | | | | |
| 1.75 | | | | | | | | | | | | |
| 2.00 | | | | | | | | | | | | |
| 2.25 | | | | | | | | | | | | |
| 2.50 | | | | | | | | | | | | |
| 2.75 | | | | | | | | | | | | |
| 3.00 | | | | | | | | | | | | |
| 3.25 | | | | | | | | | | | | |
| 3.50 | | | | | | | | | | | | |
| 3.75 | | | | | | | | | | | | |
| 4.00 | | | | | | | | | | | | |
| 4.25 | | | | | | | | | | | | |
| 4.50 | | | | | | | | | | | | |
| 5.00 | | | | | | | | | | | | |
| 5.50 | | | | | | | | | | | | |
| 6.00 | | | | | | | | | | | | |

Use one sheet for minus on plus or plus on plus. Use a second sheet for the compound not on the first sheet; and on the same sheet: Convex Meniscus, Concave Meniscus, and Plano Torics under their respective columns.

Foci not listed should be requisitioned from Army Base Stock Depot on the Spectacle Requisition Form.

# SECTION X

# MARKING AND CUTTING

# MARKING AND CUTTING

## CENTERING

A lens may have two centers, a geometrical center and an optical center. The geometrical center is at a point on the diameter of the lens half-way between the two points where the diameter cuts the circumference. (See Fig. 1.). The optical center is that point on the lens through which light passes unrefracted. In a spherical lens this point is the center of curvature, the thickest point of a convex lens and the thinnest point of a concave lens. A plano lens may be said to have an infinite number of optical centers since light may pass through it at any point without refraction.

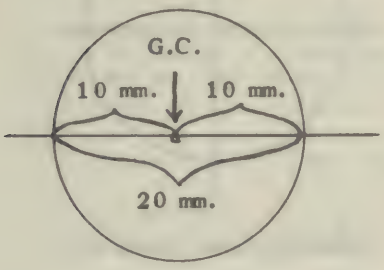



Figure 1

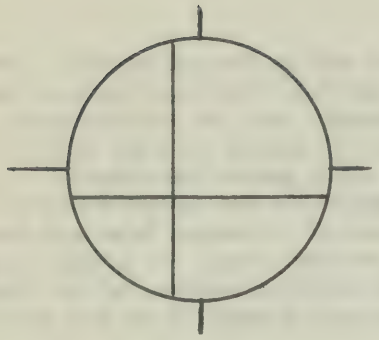
The geometrical center of a lens and the optical center may or may not be at the same point, according to the way the lens has been ground. The geometrical center of the lens may be determined by geometric measurement. The optical center can not be determined by geometric measurement; the finding of the optical center is termed "Centering".

To find the optical center of a lens we employ a combination of the two principles already described and explained in neutralization, in fact centering is refined neutralization, using an optical cross. An optical cross consists of a horizontal line and a vertical line intersecting at right angles. The cross must be large enough so that when viewed through a lens the lines will extend beyond the edges of the lens. The average centering machine has an optical cross mounted on a sliding carriage so that it may be varied from one to thirty inches from the lens, depending on the focal length of the lens, thus enabling the operator to adjust the cross so the lines will always extend beyond the edges of the lens.

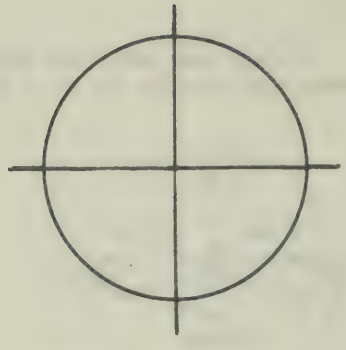
When viewing the optical cross through a spherical lens the intersection of the cross and the optical center must coincide or the lines of the cross will not be continuous at the edges of the lens. (See Fig. 2). When the lines are not continuous at the periphery of the lens move the lens until they are, then the optical center of the lens is indicated by the intersection of the lines of the optical cross.

In the case of a cylindrical lens, or one having a cylindrical element, it is necessary to determine its axis; the meridian in which the cylinder has no power. Methods for doing this have been explained under Neutralization. When using the centering machine, a lens measure is perhaps the quickest and easiest method of obtaining an approximate axis.

Having found the approximate axis or base curve of the cylinder, hold the lens to the optical cross with the axis along the horizontal line of the cross, adjusting the lens until the horizontal line is continuous and unbroken through the lens. Now adjust the lens horizontally until the vertical line is also continuous and unbroken through the lens, now the lens is centered and on axis for 180 degrees. Place three dots on the lens: one where the lines of the cross intersect, indicating the optical center, and one at each edge of the lens on the horizontal line, indicating the axis line of the cylinder.

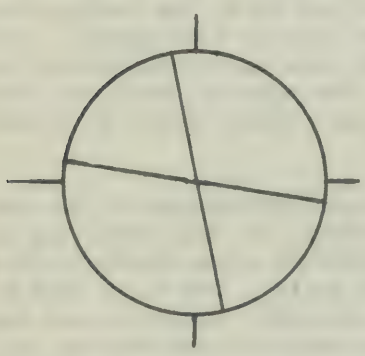


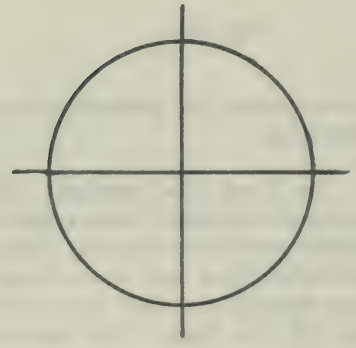
Sphere lens off center



Sphere lens centered

Figure 2





Cylindrical lens off axis and cylindrical lens with axis and center correct

Axes are figured in degrees from zero to 180, clockwise. Axis at such-and-such a degree means that the base curve of the cylinder, the meridian of no power, is that many degrees from horizontal, or zero degrees, in a clockwise direction. (See Fig. 3.).

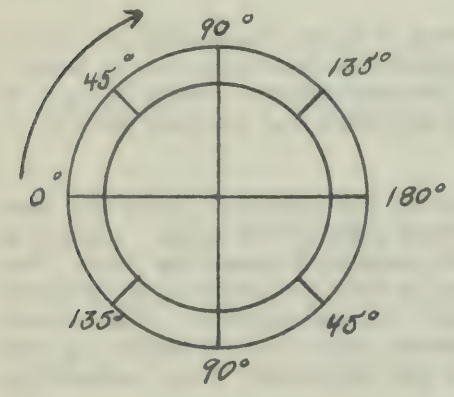



Figure 3

To center a lens for any given axis, first center it for 180 degrees as explained above. Then place the lens on the protractor concave side up with the optical center dot at the intersection of the 180 and 90 degree lines and the two axis dots along the desired axis. Now make new dots along the zero or 180 degree line. This is the cutting or edging line. Erase the dots on the axis of the cylinder to avoid confusing it with the cutting line. Mark in the cutting line with a grease pencil or some other suitable waterproof agent. This will not rub off upon later handling. Now when the lens is cut along this line the axis of the cylinder will stand at its correct degree in the fashioned lens.

Some centering machines are made with a rotating optical cross. Such machines always have an automatic device which marks the horizontal or cutting line of the

lens. When this type of machine is used, set the optical cross at the desired axis, hold the base curve of the cylinder along the axis line of the cross, and mark the lens with the automatic device, thus indicating the cutting line.

## PROCEDURE

To center a spherical lens, hold it about eight (8) inches from the eye, and view an optical cross through it. Move the lens horizontally or vertically until all lines of the cross are continuous throughout the lens and unbroken at the edges.

Place a dot on the lens where the lines of the cross intersect.

To center a lens with a cylindrical element, using a stationary optical cross, first find the approximate axis of the cylinder.

Holding this curve parallel with the horizontal line of the optical cross rotate and move the lens until the lines of the cross are continuous both within and outside the lens. Place three dots on the lens, one at each end of the horizontal line, and one at the intersection of the lines.

Next place the lens on a protractor with the line of dots along the desired axis and place new dots along the horizontal line of the protractor. Then erase the original peripheral dots and mark in the cutting line with a grease pencil.

## DECENTERING

DECENTRATION - The distance between the optical center of a lens and its actual or geometrical center measured in millimeters.

It is often impractical to fashion a pair of glasses so that the patient's eyes will look through the optical center and the geometrical center at the same time. So, for cosmetic purposes, and to obtain prism where desired, the optical center and the geometrical center are separated.

## PROCEDURE

The protractor has a section marked off in one millimeter squares. (See Fig. 4). Place the lens on the protractor with the cutting line along the 0-180 degree line, with the optical center on the 0 mark of the millimeter grid.

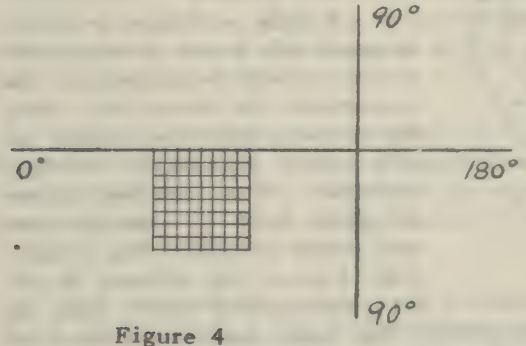


Figure 4

Move the optical center to the right or left, as the case may be, the desired distance of decentration. Place a new dot at the 0 point of the grid.

Erase the optical center dot. The new dot will be the guide for cutting and will be the geometrical center of the fashioned lens. Thus the optical center will be decentered from the geometrical center the desired distance in the finished lens.

## LENS MEASURE

Lens measures are made to measure the dioptric curve of lenses, foci of lenses are figured from curves. Lens measures are made for use on glass having

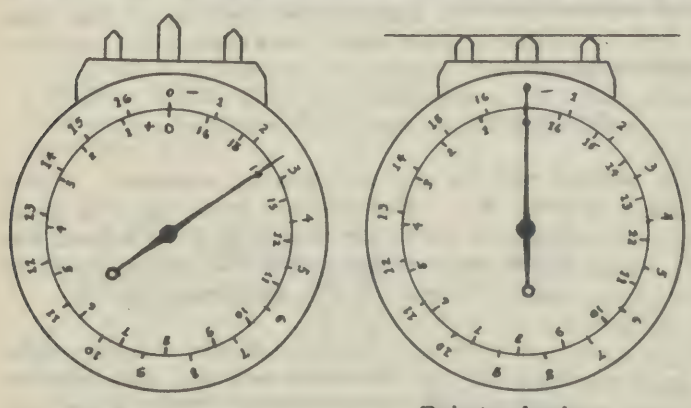
a refractive index of 1.523, which is the standard index of glass used for making opthalmic lenses.

It is often stated that lens measures are not a good method of finding the power of a lens, but that does not mean that a lens measure is not accurate to measure curves of lenses. The power of a lens is derived not only from the curves of each surface, but curves combined with thickness and optical density of the glass. Surfaced lenses are made with an allowance for vertex refraction. According to a lens measure, a lens ground plano on each surface is plano in focus, and a lens surfaced minus 6.00 on one surface and plus 6.00 on the other, if very thin, will also be practically plano. But if the lens is ground minus 6.00 on one surface and plus 6.00 on the other surface, leaving a thickness of three or four millimeters, the lens would have a power of approximately plus 0.12.

As another example, a lens having curves of minus 6.00 and plus 10.75, will neutralize as a plus 5.00 diopter, and only measure plus 4.75 diopter according to a lens measure. The way to figure accurate focus with a lens measure; if a curve measures between minus 6.00 and minus 6.12, the curve is called by the smaller numeral in minus, in this case minus 6.00, and if the curve is between plus 6.87 and plus 7.00, or plus 7.87 to plus 8.00, call the curve by the larger numeral in plus.

Lens measures resemble a pocket watch in appearance, some have all dial markings in black, while others have red and black numerals. The black-numeraled variety measures minus, to the right of zero or plano, and plus to the left of zero. When using the measure having both red and black numerals, plus is indicated by the black numerals and minus by the red numerals.

Lens measures are made with three steel points, the two end points stationary and the center point movable. The center point governs the dial hand showing the curve in question. The dial hand at rest may point to any numeral on the dial, but when the points of the measure are placed on a flat surface the hand will register zero. (See Fig. 5.).



Points Free

Points Against a Plane Surface

Figure 5

A sphere focus lens is ground with one spherical curve on each surface. To ascertain the focus of a lens by curves, add the curves of the lens algebraically. Example: If a lens has curves of plus 6.00 on one surface and minus 10.00 on the other, the focus is minus 4.00 diopters, and if a lens is plus 4.25 on one surface and minus 1.25 on the other, the focus would be plus 3.00 diopters. A cylindrical surface has two different curves on one surface. The difference between the weaker and the stronger curve of a cylinder is the power of that cylinder. As an example: If a surface is plano in one meridian and has a minus 2.00 curve in the other the lens has a minus 2.00 diopter cylinder, or if a lens has a plus 6.00 curve in one meridian and plus 9.00 in the other the power of the cylinder is plus 3.00 diopters.

A lens ground with a cylindrical element has two curves on one surface and a spherical curve on the other surface, the combination of curves making a lens compound or plano cylindrical. The axis of a cylinder according to curve is the weakest curve on the cylindrical surface. The weakest cylinder curve or axis curve is called the base curve or the fundamental curve of the lens. The weaker or base curve added algebraically to the sphere curve on the opposite surface of the lens equals the sphere dioptric power.

As an example: A lens having curves of plus 6.00 to plus 9.00 on one surface and minus 8.00 on the other surface is in focal strength, minus 2.00 diopter sphere combined with a plus 3.00 diopter cylinder. A lens equivalent in focus to this but ground on another base curve is a lens having curves of plano to plus 3.00 on one surface and minus 2.00 sphere curve on the other surface.

## PROCEDURE

Hold lens in left hand, with finger-tips along edge of lens, convex surface of lens outward. Hold lens measure in right hand, placing the measuring points as close to the center of the lens as possible, holding the measure at right angles to the lens. Hold the measure stationary and rotate the lens about three fourths turn. If the hand of the measure moves the lens has a cylinder on that surface. The power of the cylinder will be indicated by the difference between the lesser and the greater reading.

Repeat this operation on the other surface of the lens obtaining the difference between the curve of the concave surface and the least reading of the cylindrical surface for the sphere power, and the difference between the readings on the cylindrical surface will give the power and sign of the cylinder.

## CUTTING WITH A HAND DIAMOND

The hand diamond is usually a diamond point held in a metal clasp with a wooden handle. The position in which it is held and the pressure exerted together determine the cutting possibilities. The customary method being to hold it as one holds a pen or pencil and apply it at a 90 degree angle to the surface of the lens. The technique requires practice and since the diamond may be ruined by improper angle and pressure, the student would better practice with a pen or pencil until proficient. Holding the cutter in vertical position and making not more than two sweeps around the pattern should become habitual. In no case should the cutting overlap, for there is no surer way of ruining the point of a diamond than by making one cut over the other.

The novice must also learn to distinguish between a scratch and a cut of the diamond. A scratch of the diamond does not penetrate the surface of the lens to any extent making it very difficult to break the glass away evenly. A good cut can be seen through the edge of the lens, penetrating the glass, and it can be broken away cleanly and evenly.

The diamond that cuts with a very slight pressure is not necessarily the best, for a diamond that needs definite pressure, while not rasping, or scratching, is more likely to cut through a thick lens.

## PATTERNS

In cutting with a hand diamond, cutting patterns must be employed. These may be made of zylonite, sheet metal, or other suitable substance, the proper thickness

being 1/100 of an inch. The pattern must be marked with an optical cross whose point of intersection is geometrically centered. The way in which the diamond is to be used in conjunction with the pattern is usually marked on the diamond by a flattened surface of the diamond clasp which should be held parallel with the edge of the pattern.

In cutting a lens for hand edging, it is necessary that the pattern be of the size and shape of the required lens. In this case the spread or distance of the hand diamond from the pattern is ample to allow for edging. When cutting a lens for an automatic machine edger, it is best to use a pattern a size larger. This makes the lens, when cut, about 2 mm. oversize. This use of an oversized pattern is especially important where a rimless lens is desired, this allows for slight flakes or irregularities in the cutting of the lens.

## PROCEDURE

Have lens centered for cutting and edging.

Select a cutting pattern, the size and shape of the required lens if it is to be a hand-edged lens. If it is intended for automatic or rimless edging select a pattern one size larger than the required lens.

Hold the pattern on the lens, the horizontal line of the pattern on the cutting line of the lens, the concave surface of the lens upward, the left thumb holding the pattern to the lens, the thumb side of the first finger of the left hand under the lens, resting the surface of the lens on the bench for support. Holding the cutting diamond at right angles to the surface of the lens, with the flattened steel portion of the handle parallel with the pattern, begin at one end of the pattern at an average pencil stroke speed. Now turn the lens so as to cut the other half of the pattern, taking care not to overlap the diamond cut.

The lens is now ready for chipping or crumbling.

## CHIPPING AND CRUMBLING

This process constitutes the removal of the surplus glass outside of the diamond cut. When it is removed by breaking away cleanly and in fairly large-sized fragments, it is known as chipping, the ideal method. When this cannot be done and the surplus glass has to be "chewed" away, it is called crumbling.

For either operation a pair of chipping pliers is used, having a spring device in the handle which holds the jaws apart. The jaws are oblong and at right angles to the handle, their inner surface, or grasping surface, being corrugated or file like in appearance. The chipping of the glass is done with the ends of the jaws of the pliers. The pliers should never reach inside the line of cut. They should be made to grasp the edge of the lens outside the diamond cut with just sufficient grip to hold firmly. The breaking away of the glass is not accomplished by pressure of the jaws on the glass, this will splinter the lens across the cut, but accomplished by twisting the pliers down and away from the cut.

If the diamond cut on the glass is good the glass will break away easily and cleanly. If the cut is a mere scratch it will not; and the crumbling method must be used. A lens can be brought to edging shape and size by crumbling alone, but it is slow and at best a poor method, involving risk of breaking the lens.

## MARKING AND CUTTING

### PROCEDURE

Hold the lens in the left hand with the cut surface upward. Place the thumb on the top surface and the thumb side of the first finger on the under surface even with the cut on the side away from you. Apply the jaws of the pliers to the surplus glass, next to the finger on the underside, at the thinnest portion of the surplus glass, be sure the jaws do not overlap the cut. Then by a twisting motion of the hand and wrist, twist down and away from the lens chipping the glass cleanly.

Work around the lens in a clock-wise manner turning the lens in your left hand as you proceed, as you would turn a piece of paper when cutting it with a pair of scissors.

If the glass does not give or break way easily, resort to crumbling. Use the same method of holding the lens and pliers, taking not more than a millimeter or two bite with each motion.

INSTALLATION - Wipe off the grease applied to parts for protection during shipping. Oil thoroughly for ease of operation, and attach Lever "G" to the base of the machine with the taper pin provided for that purpose.

CHANGING PATTERNS - Push back Lever "A", which removes contact shoe "C" away from the pattern. Turn knurled collar "B" to the left and pattern will drop down onto lens table. Pattern can be put in operative position by simply placing on Chuck "E" and pushing up in place. Change patterns for shape only. Size is controlled by turning handwheel "P".

SETTINGS FOR SIZE - Turn micrometer handwheel "P" until scale "N" points to the size wanted. When machine is received, this adjustment should be verified before doing any actual work. To do this, cut a sample lens to any convenient shape and size and measure the major axis. If the dial does not read correctly according to the size just cut, loosen screw "O" and turn dial "N" until the scale registers correctly for that size.

Any convenient allowance may be made for edging. Once scale "N" is set, screw "Q" should be tightened firmly and the adjustment left unchanged, except when the diamond is reset, at which time it is well to recheck for size.

ADJUSTABLE HEAD - To cut plano, concave or convex lenses, set the head in proper position according to scale "M" by engaging latch "L" in the proper hole. Always make sure that the diamond point is as nearly radial to the curve of the lens as possible.

LENS HOLDER - To raise and move lens holder "F" away from the lens table, throw handle "H" to the right. This lens holder has been carefully adjusted before leaving the factory and should not be tampered with.

CONTACT SHOE - Contact Shoe "C" has also been carefully adjusted at the factory by regulating screw "D" so that the shoe follows the outline of the pattern faithfully, regardless of the shape and size of the lens being cut. When cutting octagonal lenses we recommend turning crank "K" more slowly than when cutting regular shapes.

ALIGNING AXIS ON LENS TABLE - To center and align the axis accurately on the lens table, head of machine may be tilted back out of the way by pushing knob "J" straight back. This provides a clear view of the lens and lens table and the operator can look directly down on the lens thereby assuring proper centering and alignment of axis.

CUTTING OPERATIONS - To raise lens against diamond, press on lever "G". This lever is very delicately balanced and very slight pressure is required. To rotate lens, turn handle "K" in a clockwise motion. The diamond should make a complete revolution and should *NEVER* be run over the cut twice, as the cutting point might be destroyed.

A good way to prevent this is to start cutting with crank "K" at the bottom, and make one complete revolution, which is readily indicated when the crank is again at the bottom.

LUBRICATION - Once a month the spindles of this machine, at the points marked "Oil" in (Fig. 1.), should be oiled with a good grade of light machine oil. The other movable parts also should be lubricated from time to time according to the frequency with which the cutter is used.

## CROSS CYLINDERS

Some years ago it was customary in making an examination to test each meridian of an eye separately. Prescriptions were written and lenses were made in cross cylinder form. In flat form this could be easily done. But with the advent of the curved form of lens it became increasingly difficult.

There are some practitioners who still cling to the old method and write their prescriptions as crossed cylinders even though the lenses are to be made as sphero-cylinders, or torics.

It was found that a prescription written as crossed cylinders may always be transposed to an equivalent sphero-cylinder lens with either a plus or minus cylinder power. Where the two cylinders are at right angles, this transposition is comparatively simple. If, however, they are crossed obliquely, the computation becomes somewhat complicated and uncertain.

A mathematical solution of the problem of obliquely crossed cylinders require the application of higher mathematics, particularly if the thicknesses and separations of the individual elements are to be considered. In any mathematical solution the location of the resultant axis with respect to the axes of the original cylinders is largely a matter of conjecture.

The graphical method given here is sufficiently accurate for all practical use and has the advantage that it gives the definite position of the resultant axis.

1. If the axes are crossed at 90 degrees.
   (A) Two crossed cylinders of equal power are equivalent to a sphere of the same power as either.

Ex. +1.00 axis $90^{\circ}$ ⊂ +1.00 c axis $180^{\circ}$ is equivalent to +1.00 sph.

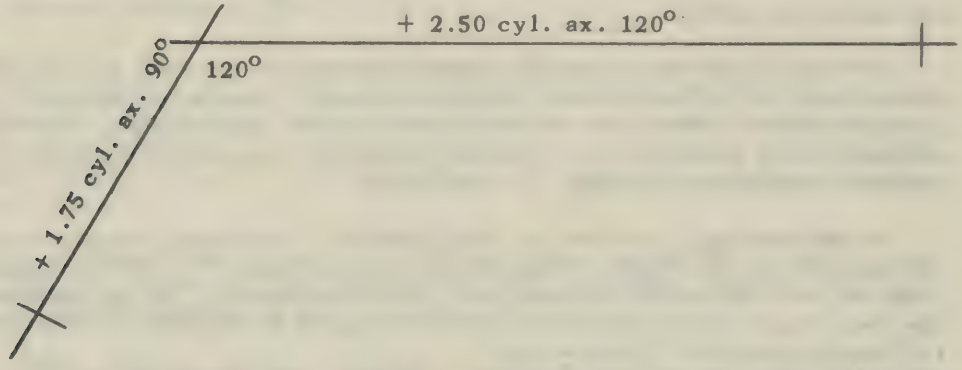
   (B) Two crossed cylinders of unequal power are equivalent to a lens having a sphere power equal to the second combined with a cylinder of power equal to the difference between the first and second, with the axis the same as that of the first.

Ex. +2.50 c axis $180^{\circ}$ ⊃ +1.00 c axis $90^{\circ}$ is equivalent to +1.00 s ⊂ +1.50 c axis $180^{\circ}$.

2. If the axes are crossed obliquely.
   (A) Graphical solution.
   This solution may be best understood by means of an example. Let us suppose that the Rx is -2.50 cyl. axis $30^{\circ}$ ⊃ +1.75 cyl. axis $90^{\circ}$.
      (1) Transpose so that both cylinders are of the same sign, preferably +. Transposed the Rx is -2.50 sph. ⊂ +2.50 cyl axis $120^{\circ}$ ⊂ +1.75 cyl. axis $90^{\circ}$.
      (2) Find the angle between the axes of the two cylinders. $120^{\circ} - 90^{\circ} = 30$.
      (3) Multiply this angle by 2 and subtract the double angle from $180^{\circ}$, $30^{\circ} \times 2 = 60^{\circ}$, $180^{\circ} - 60^{\circ} = 120^{\circ}$.
      (4) Lay off this angle with the protractor. This can be done conveniently by using a rather thin piece of paper. Place it over an ordinary protractor and with the aid of a ruler trace the lines with a sharp pencil.

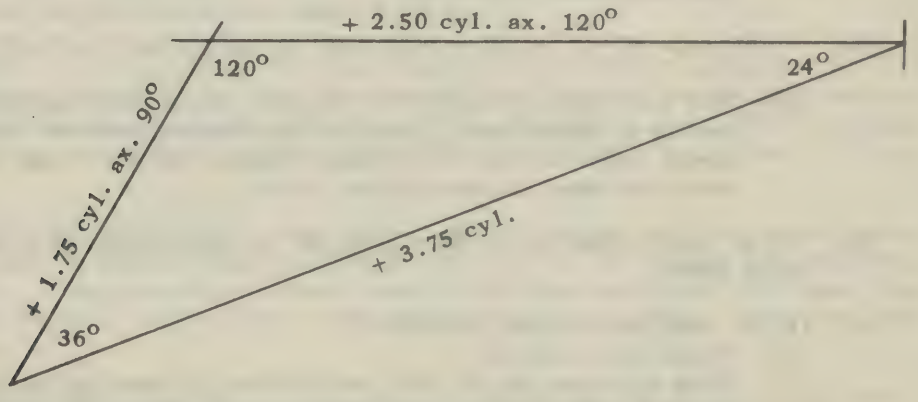
(5) Mark one side of the angle +2.50 cyl. axis 120°, and mark the other side of the angle +1.75 cyl axis 90°. Note that the sides of the angle will not conform to the 120° and 90° meridians.

(6) On the side marked +2.50, measure 2.5 units of length. Use inches or any other convenient unit. On the side marked +1.75 measure 1.75 of the same unit.




(7) Complete the triangle. Measure the third side, using the same unit of length as before. In this problem the third side measures 3.75. The power of the required resultant cylinder is +3.75 D.

**THE NEXT STEP IS TO DETERMINE THE AXIS OF THIS RESULTANT CYLINDER**




(8) Using the protractor, measure the three angles of the triangle and mark each angle with its power. The sum of the three angles must always equal 180°. In this example the angles are 24°, 36°, and 120°.

(9) Divide each of the angles by two. In this problem $36^\circ \div 2 = 18^\circ$ and $24 \div 2 = 12^\circ$.
Note that the 36° angle is adjacent to, or touching the sides of the triangle marked 90° and that the 24° angle is adjacent to the side marked 120°.

(10) The resultant cylinder axis is 18° away from 90°, and 12° away from 120°. Add the 18° to 90° or subtract the 12° from 120°. The result is 108° in both cases, and the resultant cylinder axis is 108°. $18^\circ + 90^\circ = 108^\circ$

and $120^\circ - 12^\circ = 108^\circ$. It now remains to determine the sphere power of the resultant lens.

(11) Add the two given cylinder powers, and from that sum subtract the resultant cylinder power found in 7.

+2.50 +1.75 = 4.25
+4.25 -3.75 = 0.50

(12) Divide this result by 2. This gives the sphere power resulting from the combination of the two obliquely crossed cylinders. In this problem, +0.50 ÷ 2 = 0.25. The sphere power due to the crossed cylinder is +0.25D.

(13) Combine this sphere with the original sphere of the transposed Rx, if there is any. This gives the required resultant sphere power. In this problem -2.50 +0.25 = -2.25 D.

(14) From 13, 7, and 10 write the final Rx.
Here it is:
The original prescription --
-2.50 cyl axis $30^\circ \supset$ +1.75 cyl axis $90^\circ$ is equivalent to -2.25 sph $\supset$ +3.75 cyl axis $108^\circ$.

(15) Verify the solution by neutralizing the original obliquely crossed cylinder lenses with +2.25 sph $\supset$ -3.75 cyl axis $108^\circ$.

The above method is based on the following mathematical formulae:

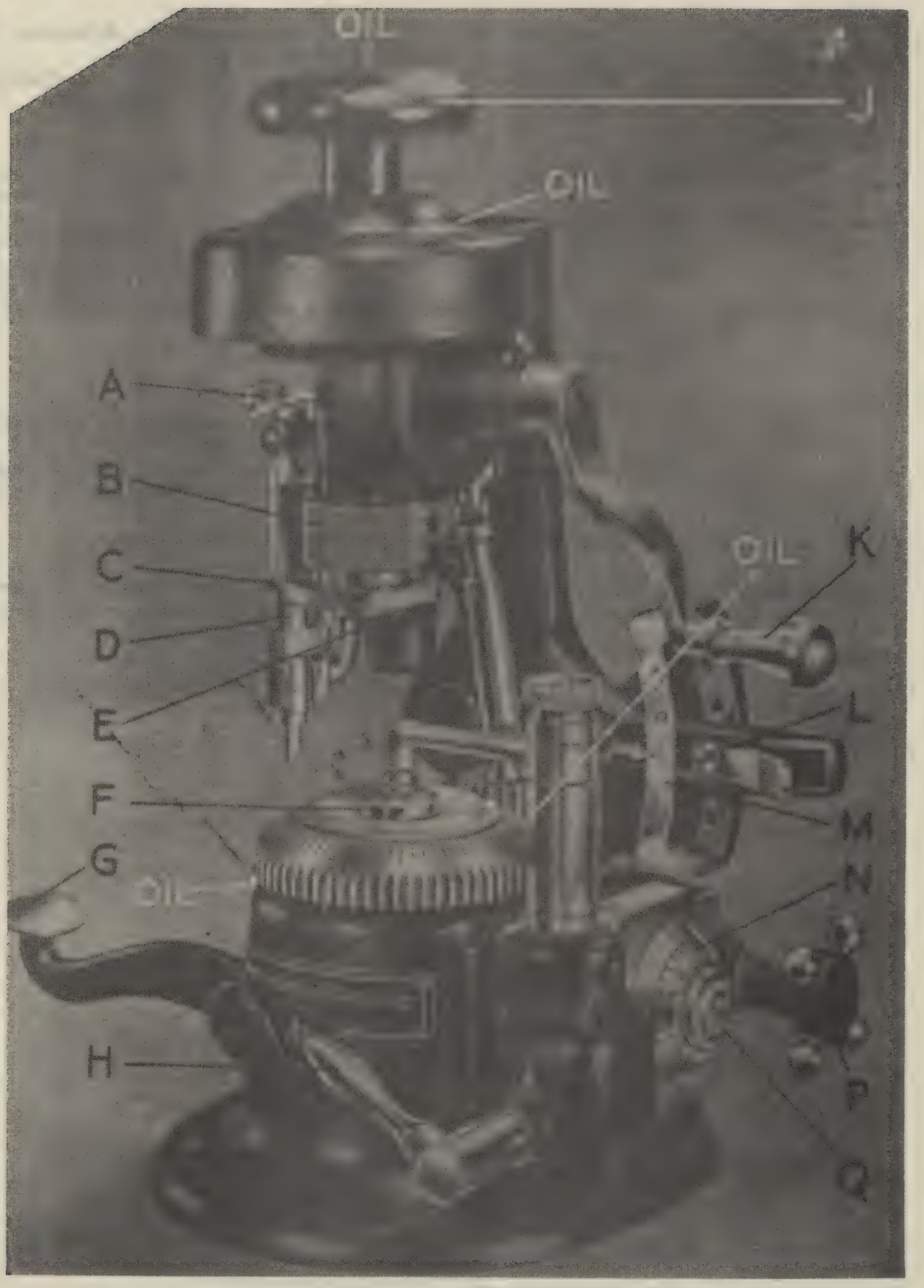
Let A and B be the powers in diopters of the given obliquely crossed cylinders, and a the angle at which they are crossed. To find the resultant cylinder C, its angle b with the axis A, and the power of the resultant sphere S.

(1) $\frac{C}{\sin 2a} = \frac{A}{\sin 2(a-b)} = \frac{B}{\sin 2b}$

(2) $C^2 = A^2 + B^2 + 2AB \cos 2a$

(3) $\sin 2b = \frac{B}{C} \sin 2a$

(4) $S = \frac{A + B - C}{2}$


OIL
J
OIL
A
B
C
D
E
F
G
OIL
H
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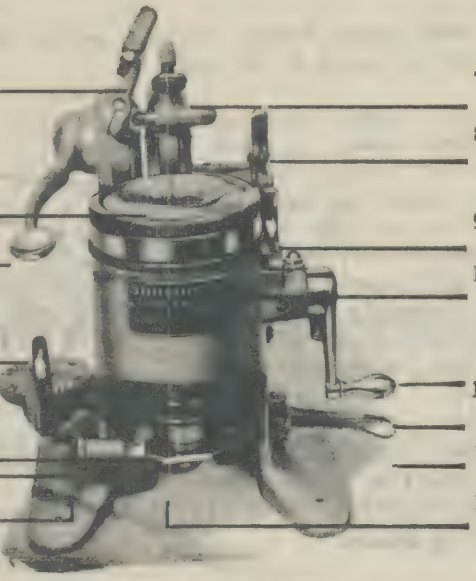
K
L
M
N
P
Q

## DIRECTIONS FOR OPERATING THE NEW NO. 82-A SHURON CUTTER




Place Edger Former of desired shape and difference on former spindle (12). An unique, spring-controlled, locking device makes it easy to put on or remove formers.

Push Former Contact Lever (11) back against base. This insures positive contact between contact point (6) and former (12).

Set Index Dial (5) to required diameter (or maximum dimension of unedged lens). An allowance of 2 mm. on odd shapes is recommended.

Place lens on Lens Table (2). Direct overhead view insures accuracy.

Hook thumb of right hand on Steady Rest (9) and pull Locking Lever (8) forward gently until snap indicates that it has locked. This brings Lens Clamping Disc (7) down on lens.

Hook second finger of left hand on Steady Rest (4). Place first finger underneath and thumb above Pressure Lever (3). Press down easily, bringing Lens Cutting Wheel (1) in contact with lens. A few experiments will enable each operator to "feel" the pressure required for most efficient cutting.

Rotate crank (10). Increase pressure on Lever (3) until wheel cuts glass. Three turns of handle (10) will rotate lens table (2) once. *Do not run over cut the second time.* When wheel starts to cut turn handle (10) steadily and quite rapidly. Do not use too much pressure.

Push back Lever (8) to release lens.

### SPECIAL INSTRUCTIONS

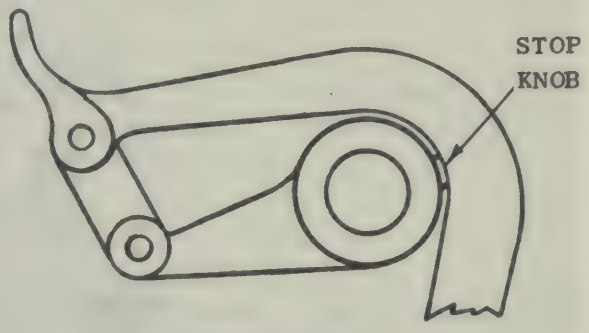
For odd shapes requiring rights and lefts, reverse former on spindle.

To remove cutting wheel, place finger-nail or penknife behind wire lock and press (or pull) forward. The entire cutting wheel assembly will come out easily.

To replace with new wheel, place wheel in small opening and snap wire lock back into original position.

To adjust for wear, move former contact point (6) in by loosening lock nut $L^1$ and using screw-driver on screw L. Relock.

To replace soft rubber pad on lens table (2) unscrew lower knurled ring (R) and lift out entire upper ring assembly. When inserting new pad make certain that one of the cross lines on the new pad coincides with the witness mark on the inside edge of ring. Replace ring assembly with pin slipping into notch of inside plate. Press down firmly and tighten lower knurled ring.




CLAMPING LEVER (8)

If clamping lever will not stay latched in forward position, stop knob should be filed down slightly. This will let the lever go a little farther forward so that it will stay in place.

Should pressure of clamping disc (7) on lens be insufficient to hold without slipping, follow instructions detailed below:

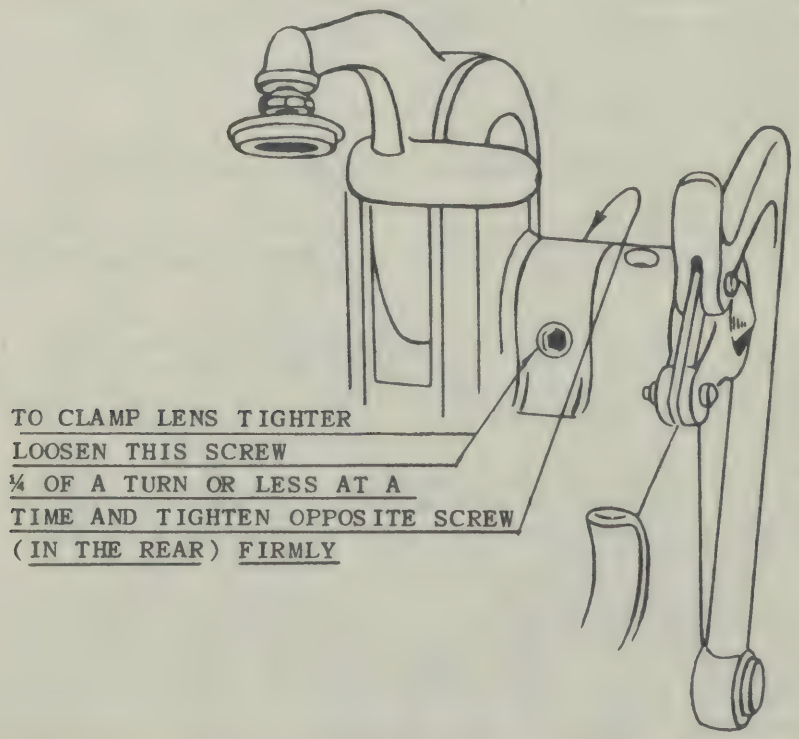
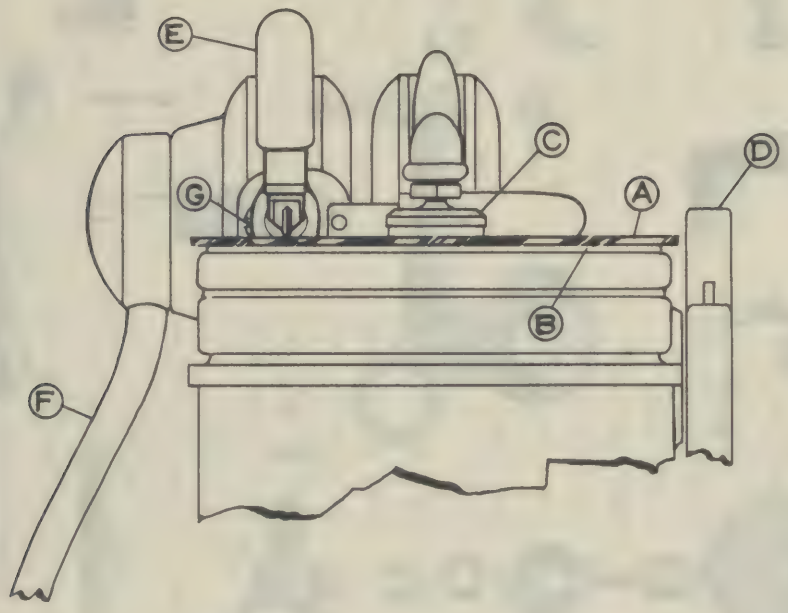
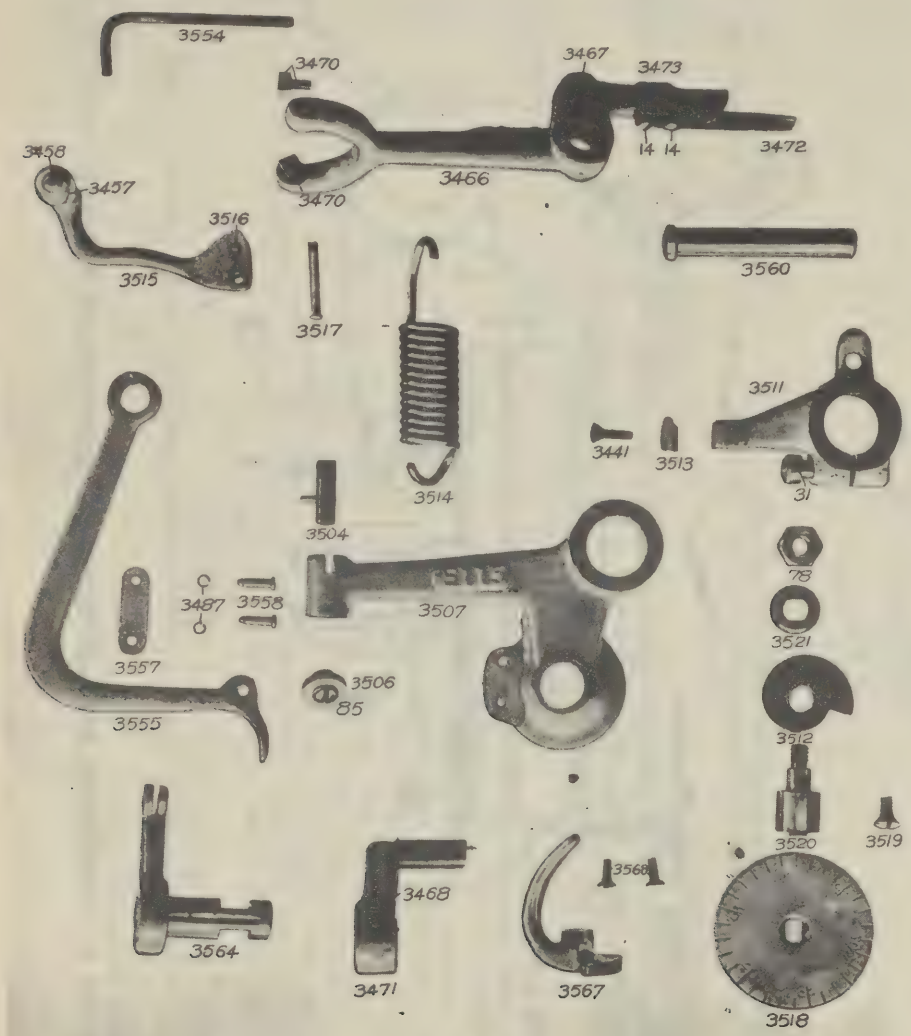


DIAGRAM SHOWING HOW TO "TRUE-UP" CUTTER WHEEL




Place flat piece of glass "A" on cutting table "B" -- clamp down "C" by pulling forward "D" -- bring cutting wheel arm "E" in contact with glass by pressing "F" -- loosen screw "G" and place "E" in vertical position then lock by tightening "G".




# REPAIR PARTS LIST

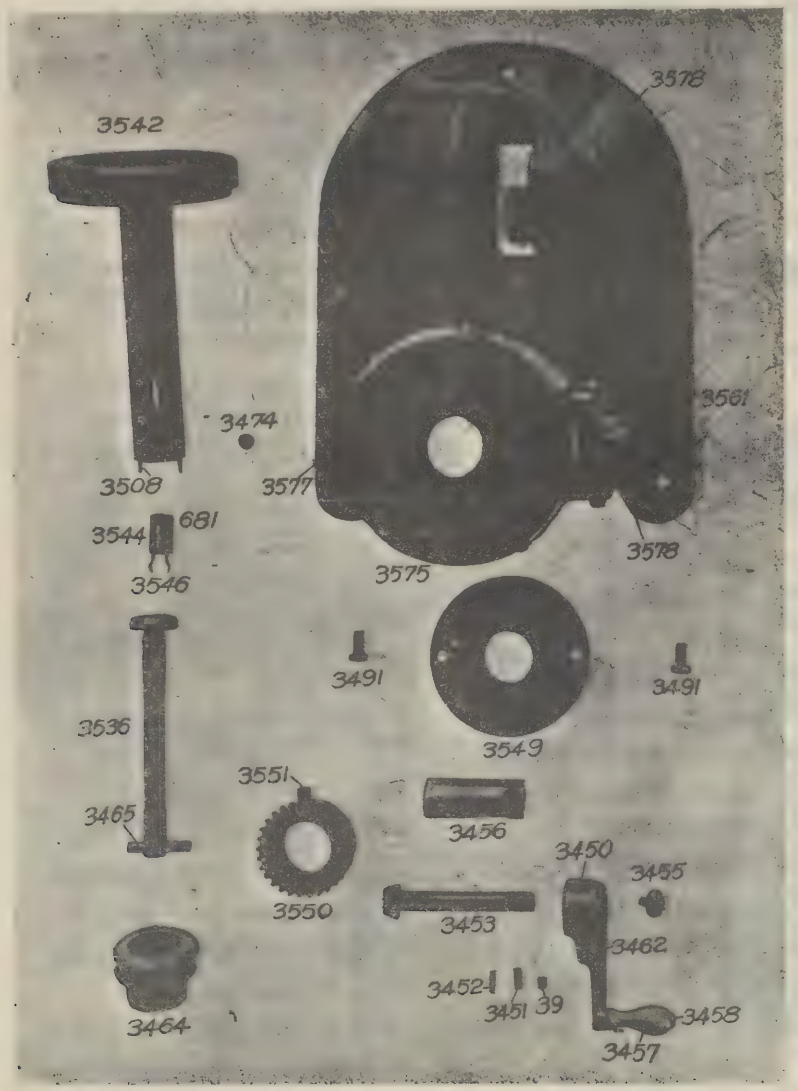
FOR THE

## SHURON NO. 82-A ALL-SHAPE CUTTER

| Stock No. | DESCRIPTION |
|---|---|
| 14 | Screw 5-40x$\frac{1}{16}$" Fil. in 3473 |
| 31 | Screw $\frac{1}{4}$-20x$\frac{3}{4}$ Fil. in 3511 |
| 78 | Nut $\frac{1}{4}$-20 in 3520 |
| 85 | Screw $\frac{5}{16}$-18x$\frac{7}{16}$ Headless in 3507 |
| 3441 | Screw for contact point in sizing dial 3511 |
| 3457 | Handle for dial spring lever |
| 3458 | Stud for crank handle (3459) |
| 3466 | Arm for clamp collar |
| 3467 | Pin for collar arm |
| 3468 | Screw for pressure crank in 3471 |
| 3470 | Guide blocks for clamp arm |
| 3471 | Pressure crank (2 3468) |
| 3472 | Pressure spring for clamp collar |
| 3473 | Pressure arm for clamp collar (2/14-3472) |
| 3487 | Clips for pins in pressure link |
| 3504 | Former contact point (887) |
| 3506 | Former contact point check nut |
| 3507 | Former contact point arm |
| 3511 | Arm for sizing dial (31-3441-3513) |
| 3512 | Cam for sizing dial |
| 3513 | Contact point for sizing dial cam |
| 3514 | Spring for sizing dial |
| 3515 | Lever for sizing dial spring (3516-3457-3458) |
| 3516 | Small pin in spring lever |
| 3517 | Large pin in spring lever |
| 3518 | Sizing dial |
| 3519 | Screw for sizing dial |
| 3520 | Spindle for sizing dial |
| 3521 | Washer for sizing dial spindle |
| 3554 | Allen set screw wrench |
| 3555 | Pressure clamp lever |
| 3557 | Pressure clamp lever link |
| 3558 | Pressure clamp lever link pins |
| 3560 | Shaft for clamp lever |
| 3564 | Clamp lever arm (3556-3559-1824) |
| 3567 | Trigger for pressure lever |
| 3568 | Screws for pressure lever trigger |


| Stock No. | DESCRIPTION |
|---|---|
| 67 | Screw 10-30x$\frac{3}{16}$" Headless pointed in 3530 |
| 3477 | Rack for angling cutter arm (3478-3480) |
| 3479 | Spring for rack 3477 |
| 3486 | Plunger for Cutting Spindle 3499 |
| 3490 | Cutter Spindle Arm (3491-3492) |
| 3491 | Cutter Spindle Arm Clamp Screw, large |
| 3492 | Cutter Spindle Arm Clamp Screw, small |
| 3493 | Pinion Spindle for Cutter Arm |
| 3494 | Pinion Spindle screw |
| 3495 | Pinion Spindle washer |
| 3499 | Cutter Spindle Assembly (3484-3485-3488-14/3489-3503) |
| 3503 | Cutter Wheel Assembly (3481-3482-3483) |
| 3528 | Rubber Ring for Clamp Arm |
| 3530 | Top Clamping Arm (67-3531) |
| 3531 | Seat for Clamp Arm Screw |

| Stock No. | DESCRIPTION |
|---|---|
| 3532 | Stud for Clamp Arm |
| 3533 | Ball pin assembly for upper clamp arm (3526-2/3527-3528-3529-3547-2/3548) |
| 3535 | Rubber table (3534-3537) |
| 3538 | Rubber table ring |
| 3539 | Clamp ring for table (3540-3541) |
| 3540 | Pin for Clamp Ring |
| 3541 | Screw for Clamp Ring |
| 3543 | Lower Ring Nut for Clamping Pad |
| 3547 | Nut for Ball Pin |
| 3548 | Rubber Washer for Ball Pin |
| 3565 | Annular Ball Bearing |
| 3566 | Pressure Lever (3579) |
| 3569 | Support for Cutter Arm |
| 3570 | Collar to support Cutter Arm (3576) |
| 3571 | Shaft for Pressure Lever |
| 3572 | Spring for Pressure Lever |
| 3576 | Screw for Cutter Arm Collar in 3570 |
| 3579 | Screw for Pressure Lever |




| Stock No. | DESCRIPTION |
|---|---|
| 39 | Screw 7-40x$\frac{3}{16}$ Headless Flat in 3450 |
| 681 | Pin in 3544 |
| 3450 | Ratchet Crank (39) |
| 3451 | Pin for Pawl in 3450 |
| 3452 | Spring for Pawl in 3450 |
| 3453 | Bevel Gear Pinion and Spindle |
| 3455 | Screw for Crank Spindle |
| 3456 | Bushing for Crank Spindle |
| 3457 | Handle for Crank |
| 3458 | Spindle for Crank Handle |
| 3462 | Ratchet Crank Assembly (3450-3451-3452-3453-3455-3456-3457-3458) |
| 3464 | Clamping Collar |
| 3465 | Pin for Clamping Collar |
| 3474 | Screw for Main Spindle |
| 3491 | Screw for Main Spindle Bearing 3549 |

| Stock No. | DESCRIPTION |
|---|---|
| 3508 | Former Pin in Main Spindle |
| 3536 | Spindle to raise rubber pad |
| 3542 | Main Table Spindle (3474-2/3508) |
| 3544 | Holder for Former (681-3545-3546) |
| 3546 | Spring for Former Holder in 3554 |
| 3549 | Main Spindle Bearing |
| 3550 | Gear on Main Spindle (2/3551) |
| 3551 | Screw on Main Spindle |
| 3561 | Trigger for Clamp Lever |
| 3562 | Screw for Trigger 3561 |
| 3575 | Main Frame (2/3491-3549-2/3551-3577-2/3578) |
| 3577 | Plug Screw in Main Frame |
| 3578 | Drive Type Oiler |

**These parts are not numbered in illustrations and are available only in assembly numbers shown in description of part.**

| Stock No. | DESCRIPTION |
|---|---|
| 887 | Pin in 3504 |
| 3459 | Washer for 3458 |
| 3478 | Stem for rack in 3477 |
| 3480 | Rivet for rack stem in 3477 |
| 3482 | Clamp for cutting wheel in 3503 |
| 3483 | Shaft for cutting wheel in 3503 |
| 3484 | Spindle for cutter in 3499 |
| 3485 | Nut for cutter spindle in 3499 |
| 3488 | Sleeve for cutter spindle in 3499 |
| 3489 | Steel Ball $\frac{1}{16}$; 14 required in 3499 |
| 3526 | Ball Pin for Clamp Arm in 3533 |
| 3527 | Ball for Clamp Arm in 3533 |
| 3529 | Support for Rubber Ring in 3533 |
| 3534 | Rubber Disc only in 3535 |
| 3536 | Spindle for Rubber Disc in 3535 |
| 3537 | Pin for Rubber Disc in 3535 |
| 3545 | Bushing for Former Holder in 3544 |
| 3556 | Arm for Clamp Lever in 3564 |
| 3559 | Shaft for Lever Arm in 3564 |

**These parts are not numbered in illustrations but may be had when necessary by ordering these numbers.**

| | |
|---|---|
| 3474 | Rubber Foot Pad for Main Frame |
| 3481 | Steel Cutting Wheel only |
| 3496 | Adaptor for A.O. Co. Formers |
| 3522 | Leather packing for 3549 |
| 3523 | Paper packing for 3549 |
| 3562 | Screw for Trigger No. 3561 |

MARKING AND CUTTING
DECENTRATION CHART

MSSS Chart 1-C-0-109

| DEC. | 0.5m/m | 1.0m/m | 1.5m/m | 2.0m/m | 2.5m/m | 3.0m/m | 3.5m/m | 4.0m/m | 4.5m/m | 5.0m/m |
|---|---|---|---|---|---|---|---|---|---|---|
| Power | | | | | | | | | | |
| 0.25 | 0.01 | 0.02 | 0.04 | 0.05 | 0.06 | 0.08 | 0.09 | 0.10 | 0.11 | 0.12 |
| 0.50 | 0.02 | 0.05 | 0.08 | 0.10 | 0.12 | 0.15 | 0.18 | 0.20 | 0.22 | 0.25 |
| 0.75 | 0.04 | 0.08 | 0.11 | 0.15 | 0.19 | 0.22 | 0.26 | 0.30 | 0.34 | 0.38 |
| 1.00 | 0.05 | 0.10 | 0.15 | 0.20 | 0.25 | 0.30 | 0.35 | 0.40 | 0.45 | 0.50 |
| 1.25 | 0.06 | 0.12 | 0.19 | 0.25 | 0.31 | 0.38 | 0.44 | 0.50 | 0.56 | 0.62 |
| 1.50 | 0.08 | 0.15 | 0.22 | 0.30 | 0.38 | 0.45 | 0.52 | 0.60 | 0.68 | 0.75 |
| 1.75 | 0.09 | 0.18 | 0.26 | 0.35 | 0.44 | 0.52 | 0.61 | 0.70 | 0.79 | 0.88 |
| 2.00 | 0.10 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 |
| 2.25 | 0.11 | 0.22 | 0.34 | 0.45 | 0.56 | 0.68 | 0.79 | 0.90 | 1 01 | 1.12 |
| 2.50 | 0.12 | 0.25 | 0.38 | 0.50 | 0.62 | 0.75 | 0.88 | 1.00 | 1.12 | 1.25 |
| 2.75 | 0.14 | 0.28 | 0.41 | 0.55 | 0.69 | 0.82 | 0.96 | 1.10 | 1.24 | 1.38 |
| 3.00 | 0.15 | 0.30 | 0.45 | 0.60 | 0.75 | 0.90 | 1.05 | 1.20 | 1.35 | 1.50 |
| 3.25 | 0.16 | 0.32 | 0.49 | 0.65 | 0.81 | 0.98 | 1.14 | 1.30 | 1.46 | 1.62 |
| 3.50 | 0.18 | 0.35 | 0.52 | 0.70 | 0.88 | 1.05 | 1.22 | 1.40 | 1.58 | 1.75 |
| 3.75 | 0.19 | 0.38 | 0.56 | 0.75 | 0.94 | 1.12 | 1.31 | 1.50 | 1.69 | 1.88 |
| 4.00 | 0.20 | 0.40 | 0.60 | 0.80 | 1.00 | 1.20 | 1.40 | 1.60 | 1.80 | 2.00 |
| 4.25 | 0.21 | 0.42 | 0.64 | 0.85 | 1.06 | 1.28 | 1.49 | 1.70 | 1.91 | 2.12 |
| 4.50 | 0.22 | 0.45 | 0.68 | 0.90 | 1.12 | 1.35 | 1.58 | 1.80 | 2.02 | 2.25 |
| 4.75 | 0.24 | 0.48 | 0.71 | 0.95 | 1.19 | 1.42 | 1.66 | 1.90 | 2.14 | 2.38 |
| 5.00 | 0.25 | 0.50 | 0.75 | 1.00 | 1.25 | 1.50 | 1.75 | 2.00 | 2.25 | 2.50 |
| 5.25 | 0.26 | 0.52 | 0.79 | 1.05 | 1.31 | 1.58 | 1.84 | 2.10 | 2.36 | 2.62 |
| 5.50 | 0.28 | 0.55 | 0.82 | 1.10 | 1.38 | 1.65 | 1.92 | 2.20 | 2.48 | 2.75 |
| 5.75 | 0.29 | 0.58 | 0.86 | 1.15 | 1.44 | 1.72 | 2.01 | 2.30 | 2.59 | 2.88 |

| Dec. Power | 0.5m/m | 1.0m/m | 1.5m/m | 2.0m/m | 2.5m/m | 3.0m/m | 3.5m/m | 4.0m/m | 4.5m/m | 5.0m/m |
|---|---|---|---|---|---|---|---|---|---|---|
| 6.00 | 0.30 | 0.60 | 0.90 | 1.20 | 1.50 | 1.80 | 2.10 | 2.40 | 2.70 | 3.00 |
| 6.25 | 0.31 | 0.62 | 0.94 | 1.25 | 1.56 | 1.88 | 2.19 | 2.50 | 2.81 | 3.17 |
| 6.50 | 0.32 | 0.65 | 0.98 | 1.30 | 1.62 | 1.25 | 2.28 | 2.60 | 2.97 | 3.25 |
| 6.75 | 0.34 | 0.68 | 1.01 | 1.35 | 1.69 | 2.02 | 2.36 | 2.70 | 3.04 | 3.38 |
| 7.00 | 0.35 | 0.70 | 1.05 | 1.40 | 1.75 | 2.10 | 2.45 | 2.80 | 3.15 | 3.50 |
| 7.25 | 0.36 | 0.72 | 1.09 | 1.45 | 1.81 | 2.18 | 2.54 | 2.90 | 3.26 | 3.62 |
| 7.50 | 0.38 | 0.75 | 1.12 | 1.50 | 1.88 | 2.25 | 2.62 | 3.00 | 3.38 | 3.75 |
| 7.75 | 0.39 | 0.78 | 1.16 | 1.55 | 1.94 | 2.32 | 2.71 | 3.10 | 3.49 | 3.88 |
| 8.00 | 0.40 | 0.80 | 1.20 | 1.60 | 2.00 | 2.40 | 2.80 | 3.20 | 3.60 | 4.00 |
| 8.25 | 0.41 | 0.82 | 1.24 | 1.65 | 2.06 | 2.46 | 2.89 | 3.30 | 3.71 | 4.12 |
| 8.50 | 0.42 | 0.85 | 1.28 | 1.70 | 2.12 | 2.55 | 2.98 | 3.40 | 3.87 | 4.25 |
| 8.75 | 0.44 | 0.88 | 1.31 | 1.75 | 2.19 | 2.62 | 3.06 | 3.50 | 3.94 | 4.38 |
| 9.00 | 0.45 | 0.90 | 1.35 | 1.80 | 2.25 | 2.70 | 3.15 | 3.60 | 4.05 | 4.50 |
| | | | | | | | | | | |
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# SECTION XI

# EDGE GRINDING

# EDGE GRINDING

OPERATION - A 1/4 H.P. motor is recommended to operate this machine if the motor is belted directly to the machine. The stone should run approximately 300 revolutions per minute, and the top should turn away from the operator, as indicated by the arrow on the stone flange.

BREAKING IN THE STONE - The stone should be run soaking wet for 24 hours before using, and always wet thereafter. Keep hone "A" (Figure 4) bearing slightly against the stone while edging. This will keep the face of the stone true and in fast cutting condition.

LENS SHAPE - The shape of the lens is determined by means of pattern D (Figure 1). Patterns are changed by merely slipping them on or off the holder G (Figure 1). The ball spring chuck assures a snug fit.

LENS SIZE - The size of the lens is controlled with micrometer wheel H. After the machine has been in use for some time, it will be found that the stone has worn slightly, and that the lens finishes oversize. To compensate for this, indicator "J" must be adjusted to reset the machine, edge any lens until no further reduction in size takes place. Remove the lens from the machine and measure it accurately. Without changing the position of micrometer wheel "H", loosen screws "I" with screw driver and turn dial "J" until it registers exactly the size of the lens just ground. Fasten the screw so that the dial is held securely in this position, and you will find that the machine is set accurately for size.

GRINDING - Release lever "K" (Figure 2) in the lens centering device and allow the jaws to open to their full capacity. Remove pad holder "L" from the machine and place it in the centering device with the rubber washer facing up, and the holes in the pad holder registering on the pins of the centering device. Then place the lenses on the rubber pad holder. The center of the axis directly over the inscribed line which connects the three holes of the pad holder. The center of the lens should rest directly over the center holes, thus locating both the major and minor axis.

If more than one lens is to be edged at the same time, place the additional lenses on top of the first, using a washer between each lens, making certain that the axis and centers coincide.

After the lenses have been correctly placed in the centering device, the upper jaw should be pressed firmly against them and Lever "K" locked into position. The centering device is now ready to be inserted between arbors "M" and "N", (Figure 3).

Before inserting the lens in the machine and to prevent unusual breakage, especially on thin lenses, it is essential that the pressure, exerted against the lens arbors "M" and "N", and controlled by adjustable nut "S", be carefully regulated. Turning counter clockwise decreases the tension. Make certain that just enough tension is applied to prevent the lens from slipping between the lens pads.

Place the centering device in the machine between "M" and "N" so that the holes in the pad holder "L" will engage with the pins in the end of the right hand lens arbor "N". This is more readily accomplished by turning clutch "P" (Figure 1) and bringing the pins in the lens arbor at a convenient position.

When the lenses have been properly placed between the lens arbors, carefully release lever "O" (Figure 3), allowing the arbors to press gently against the lenses. Then unlock lever "K" (Figure 2) and remove the centering device from the machine.

To start grinding, engage clutch "P" (Figure 1) and release trigger "O" (Figure

3), and let the grinding head come in contact with the stone very gently. It is advisable to relieve the pressure of the lens against the stone, with the hand, during the first revolution, after which the full pressure of the weight, on the left-hand side of the machine, may be applied. This pressure may be adjusted by releasing hand wheel "R" (Figure 3) and moving the weight in or out on the arm.

QUICK GRINDING - If considerable stock is to be removed from some portion of the lens, clutch "P" should be disengaged and that part of the lens kept against the stone until it is roughed out approximately to the correct size, and the lens turned to any part that may require roughing out.

This process will allow one to hasten the grinding operation considerably where the shape of the lens is very irregular. An extremely smooth finish can also be obtained if the lens is rapidly rotated counter-clockwise by hand with the clutch (disengaged) just before removing the lens from the stone.

TRUING A CHIPPED STONE - If through accident, the grinding wheel is chipped, a truing diamond should be used to turn down the stone. The diamond should be placed in hole "U" (Figure 4), and secured by screw "Y". When used, the diamond point should be brought against the face of the stone with just enough pressure to remove a small portion only at each revolution. The stone is then given the proper amount of throw by means of handwheel "T", so that the diamond point covers the entire face as it travels back and forth. The stone must be running wet during this operation.

## INSTRUCTION FOR THE OPERATION AND CARE OF EDGING MACHINES

These hand edgers are rigidly constructed and equipped with heavy, removeable bearings which, when worn, can be replaced at a small cost. With moderate care, these edgers are easily kept clean and in good running condition.

Before operating, remove all dust and grit that may have accumulated in transit and apply plenty of oil to both oil cups on the stone arbor bearings. Make sure that these two bearings are always supplied with plenty of oil. The life of the machine depends considerably on the condition of these two bearings and if allowed to run without oil the stone will be out of true in very short time and it will be difficult to turn out first-class work.

In moving the edger or setting up, do not take hold of the stone or pulley but grasp the trough or tub and make certain that the machine is level before it is screwed firmly in place.

The pulleys should turn at approximately 300 revolutions per minute for the 16 inch stone and 400 revolutions per minute for the 12 inch stone. The stone should run in the direction of the arrow stamped on it--that is, with the top running away from the operator. If possible, belt the machine from a transmission shaft underneath.

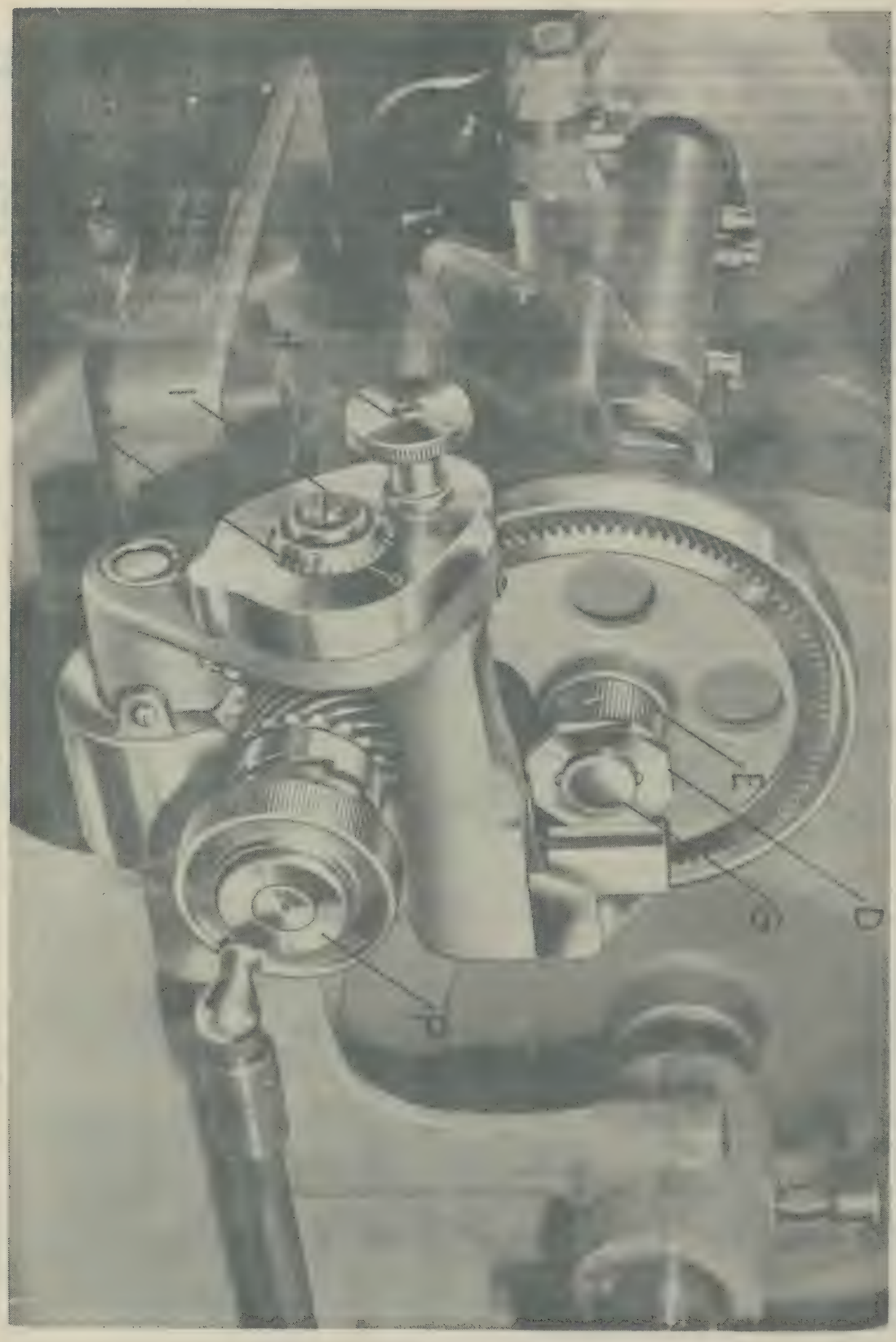
Every edger is thoroughly tested at the factory and the stone is carefully trued and honed. During transit the water still left in the stone may have settled at the lowest part causing the stone to appear out of balance, until it is again completely soaked with water. It is essential, therefore, to apply water to the stone repeatedly, until it has absorbed all it possibly can. No grinding whatever should be attempted until the stone has run soaking wet for 24 hours. NEVER EDGE A LENS ON A DRY STONE.

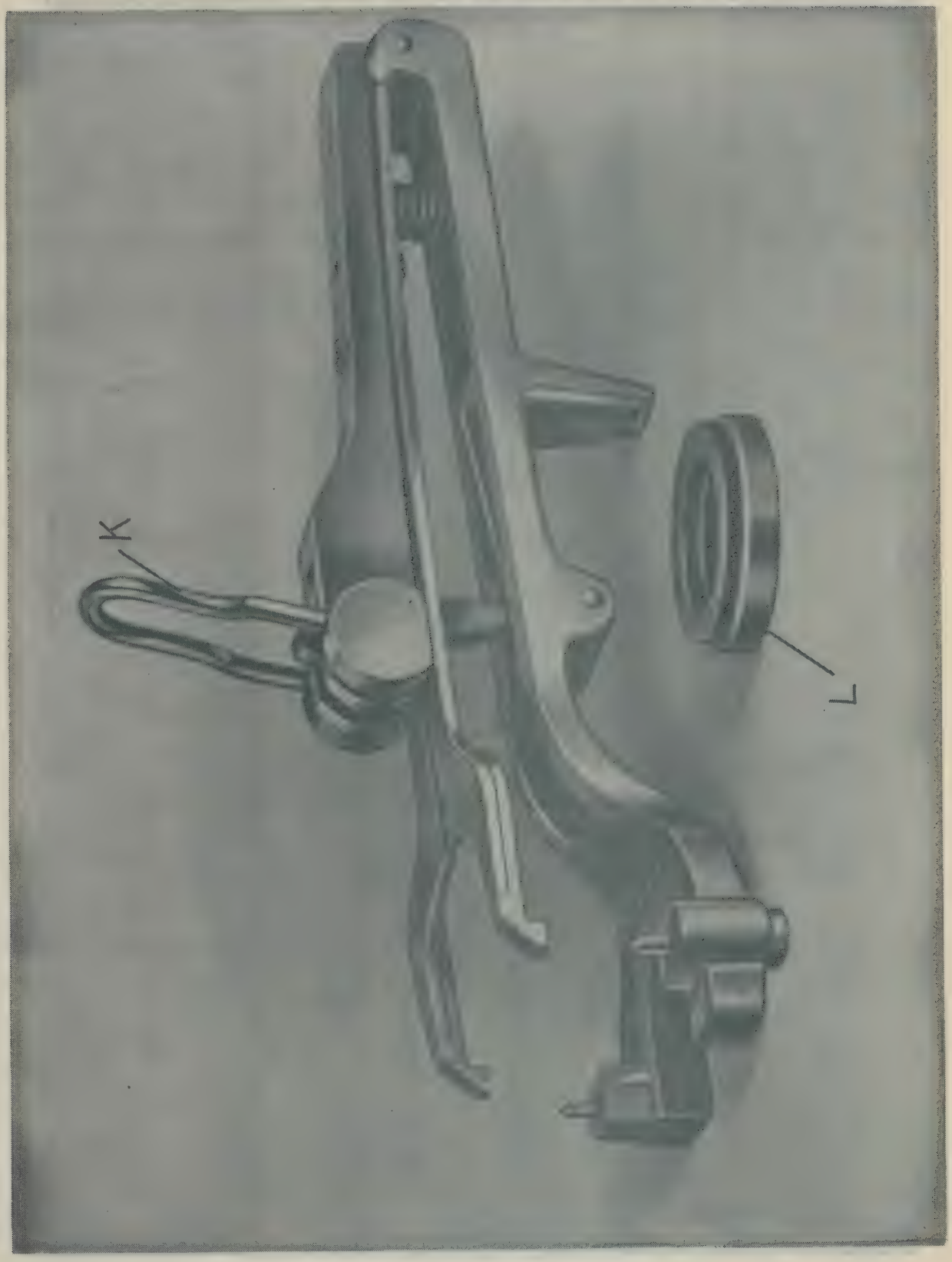
New stones have a tendency to become coarse and this should be borne in mind

when the machine is relatively new. A high grade stone is never at it's best until it has been used for some time. As the quality of the work depends entirely upon the condition of the grinding wheel, it is important that it be given all the attention and care possible.

When honing, use the device provided for that purpose. Set the hone supplied with the machine, lightly against the face of the stone. If out of true to any great extent, it will be necessary to turn the stone with a diamond. It should not be necessary, however, to use the diamond unless the grinding wheel has been damaged or chipped through accident.

As the stone wears down, the hand rest should be brought forward to compensate for wear. This can be accomplished easily by loosening the bolt that holds the hand rest to the base or tub. After the hand rest has been moved nearer the stone, the bolt should be tightened firmly.

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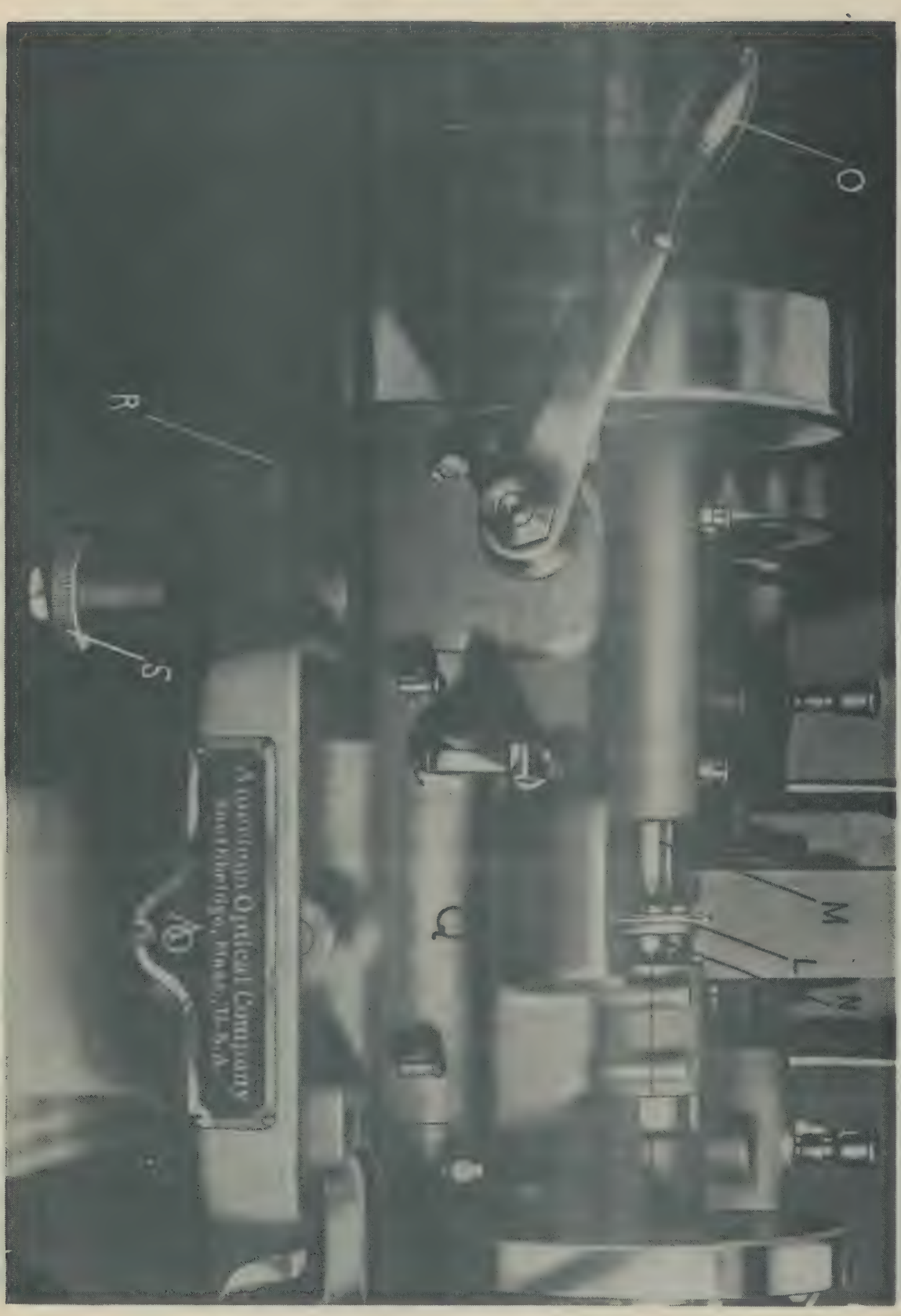
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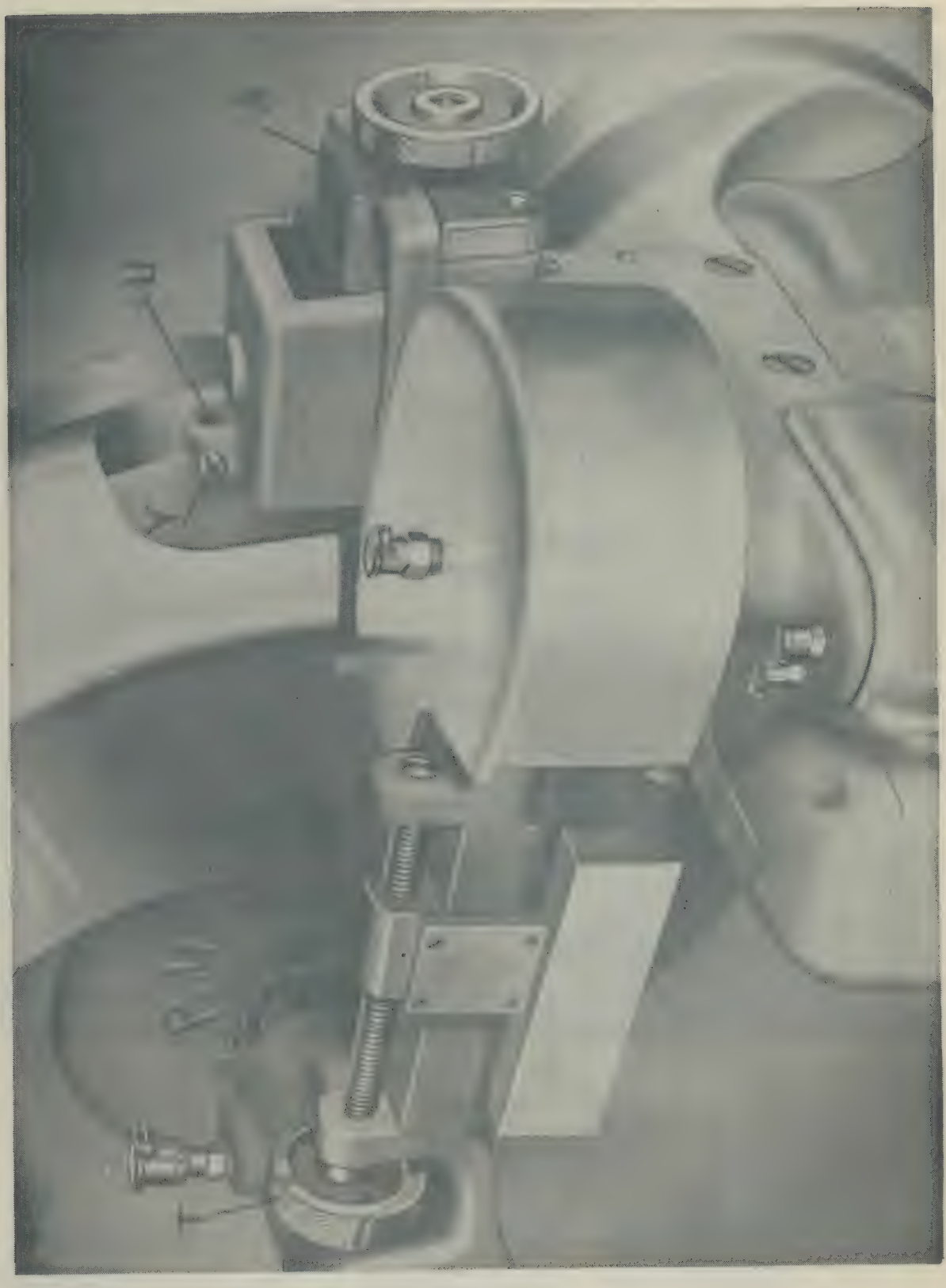
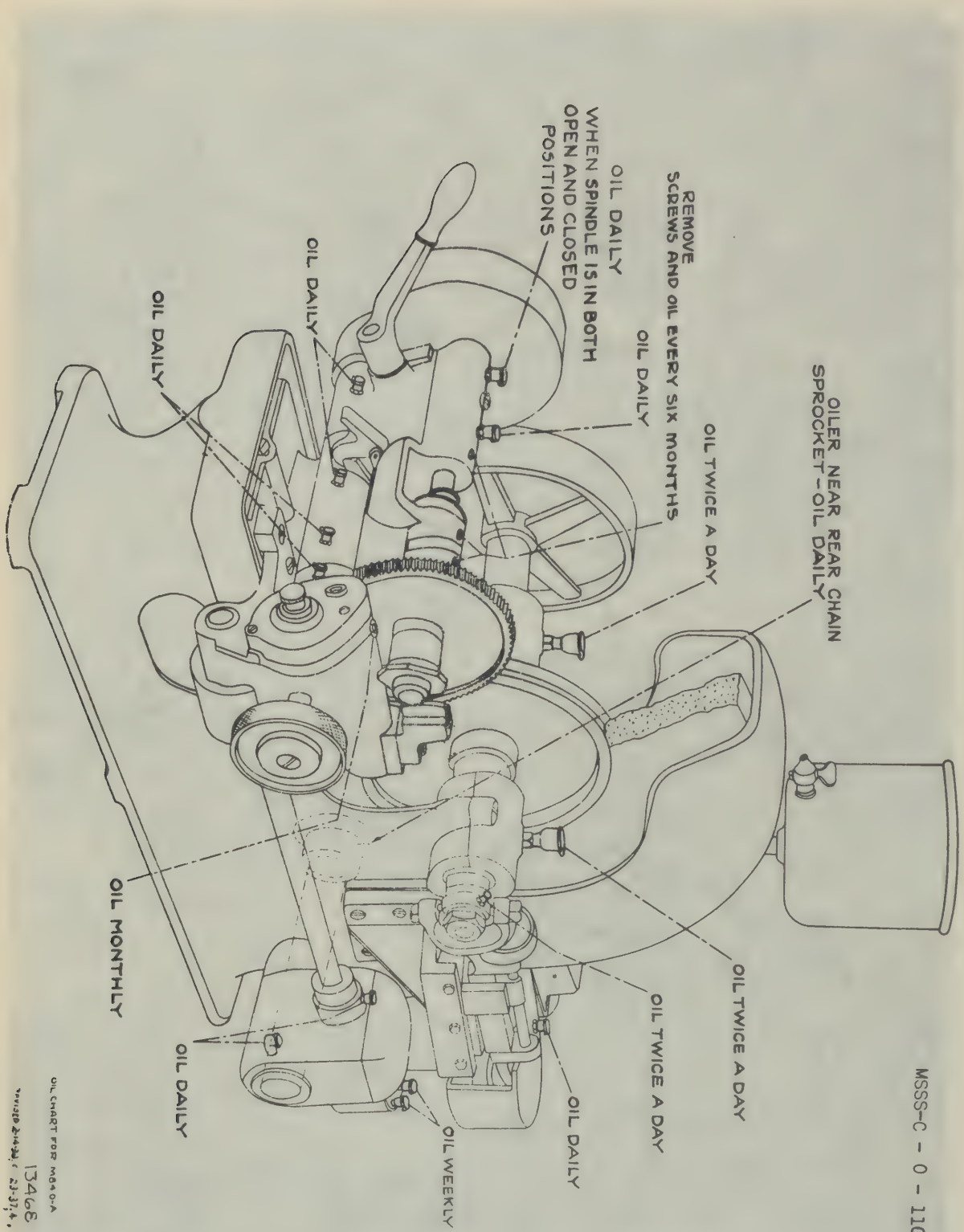
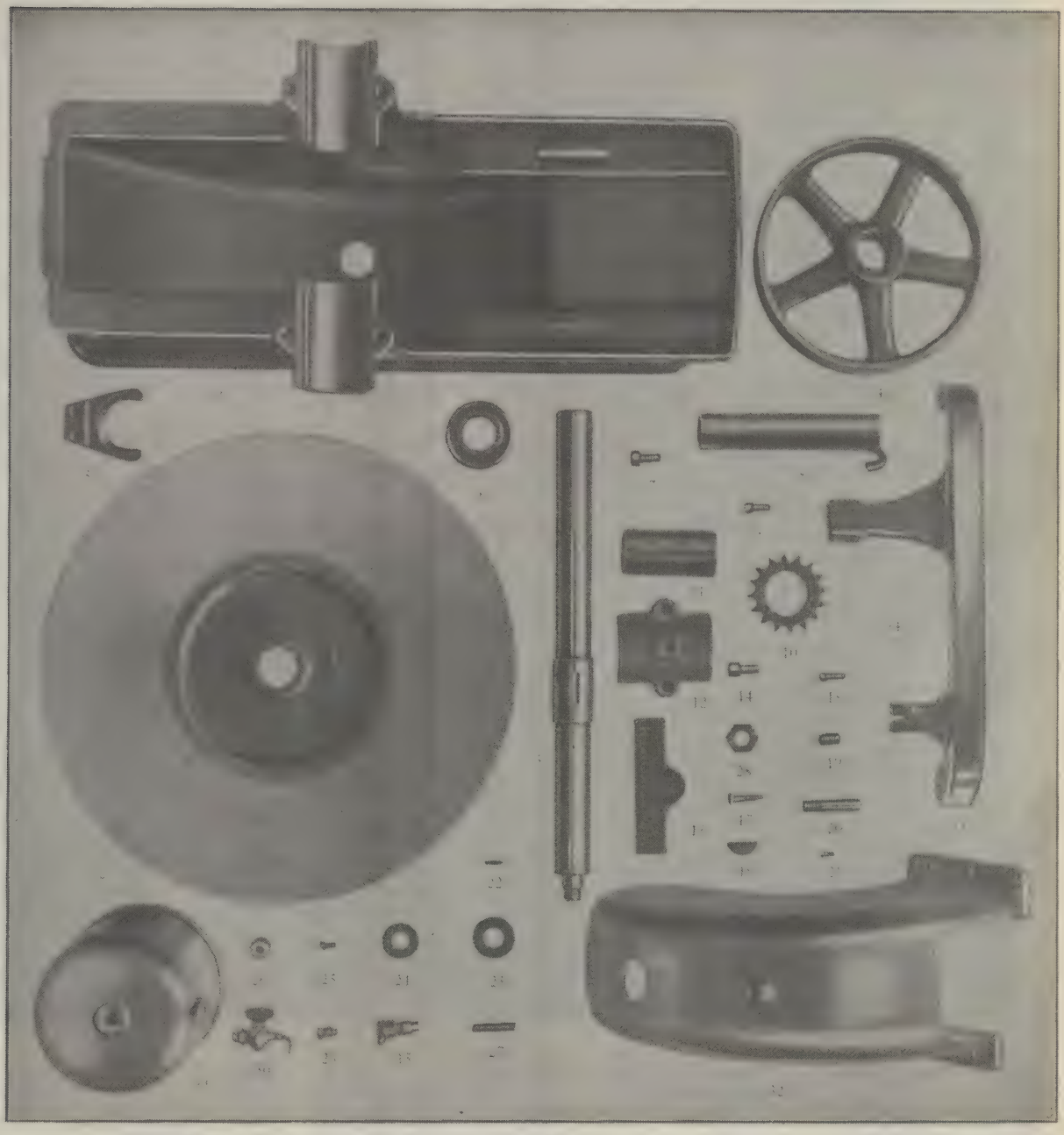
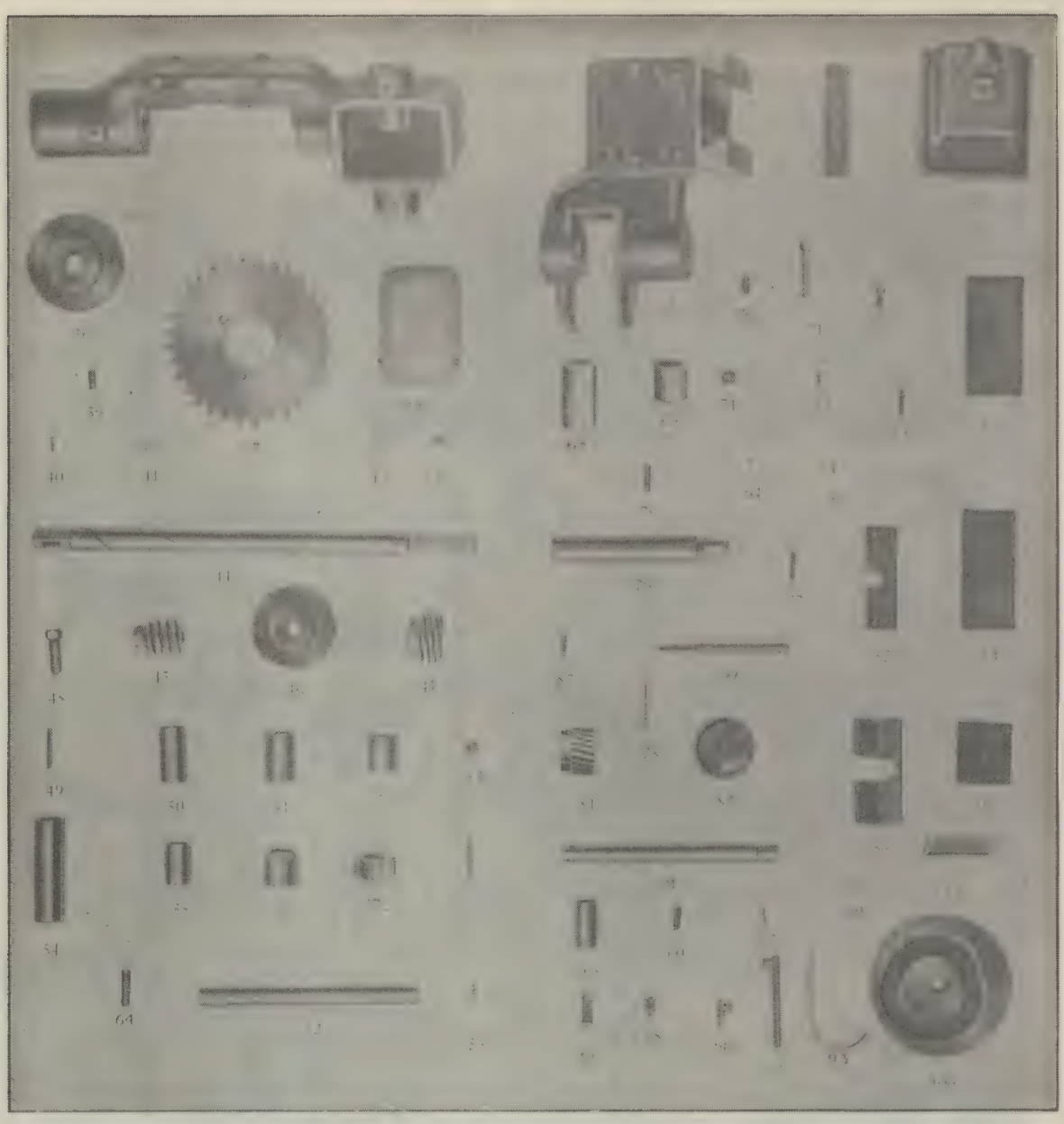



OILER NEAR REAR CHAIN SPROCKET - OIL DAILY
OIL TWICE A DAY
REMOVE SCREWS AND OIL EVERY SIX MONTHS
OIL DAILY
OIL DAILY WHEN SPINDLE IS IN BOTH OPEN AND CLOSED POSITIONS
OIL DAILY
OIL DAILY
OIL MONTHLY
OIL DAILY
OIL WEEKLY
OIL DAILY
OIL TWICE A DAY
OIL TWICE A DAY
MSSS-C - 0 - 110
OIL CHART FOR MSSS-A
13468

## REPLACEMENT PARTS - M. 840 - A



| PART NO. | DESCRIPTION | PRICE EACH |
|---|---|---|
| 1 | Base | $30.00 |
| 2 | Stone and Flange Complete | 29.00 |
| 3 | Stone Arbor | 5.50 |
| 4 | 8" Flat Pulley for Stone Arbor | 3.75 |
| 5 | Yoke for Part 6 | 1.00 |
| 6 | Sprocket Hub for Stone Arbor | 2.00 |
| 7 | Yoke Screw for Part 5 | .05 |
| 8 | Drain Pipe for Part 1 | .45 |
| 9 | Screw for Part 32 | .05 |
| 10 | Driving Sprocket for Part 6 | 2.00 |
| 11 | Bushing for Part 1 | 1 25 |
| 12 | Cap for Part 1 | $ .75 |
| 14 | Screws for Part 12 | .05 |
| 15 | Oilers for Part 12 | .15 |
| 16 | Key for Part 3 | .05 |
| 17 | Wood Screw for Part 1 | .05 |
| 18 | Screw for Part 33 | .05 |
| 19 | Set Screw for Part 4 | .05 |
| 20 | Water Tank Stem for Part 31 | .35 |
| 21 | Screw for Part 27 | .05 |
| 22 | Pin for Part 3 | .05 |
| 23 | Stone Shifting Ring for Part 3 | 1.50 |
| 24 | Thrust Washer for Part 3 | $ .45 |
| 25 | Screw for Parts 6 and 10 | .05 |
| 26 | Bushing for Part 31 | .50 |
| 27 | Key for Part 6 | .35 |
| 28 | Nut for Part 3 | .40 |
| 29 | Oiler for Part 23 | .10 |
| 30 | Valve for Part 31 | .60 |
| 31 | Water Tank with Parts 26 & 30 | 4.50 |
| 32 | Water Guard | 7.50 |
| 33 | Chain Guard | 3.50 |
| 34 | Dowel Pin for Part 1 | .05 |

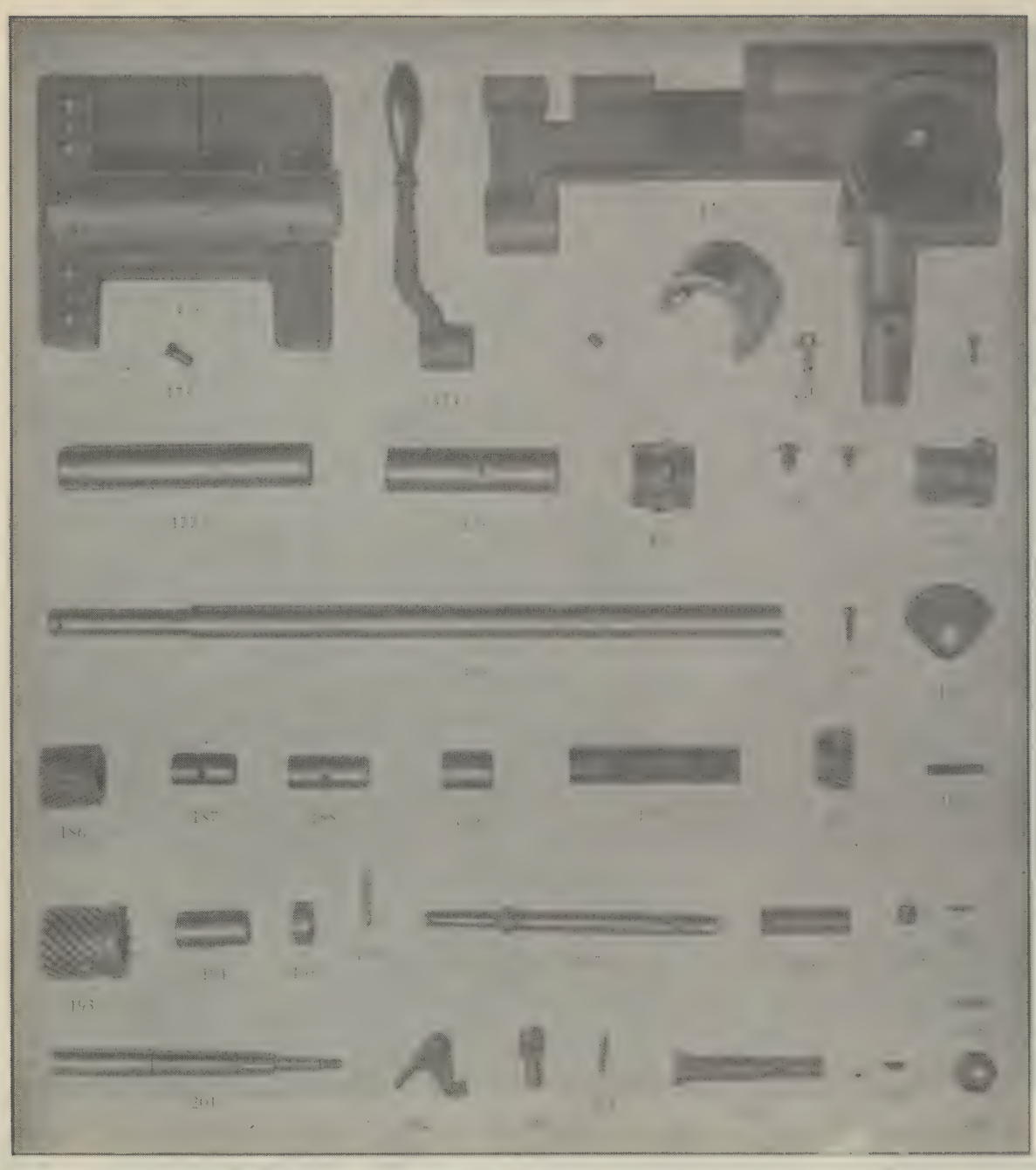


| PART NO. | DESCRIPTION | PRICE EACH |
|---|---|---|
| 35 | Back Bracket for Part 1 | $10.00 |
| 36 | Sprocket Hub for Part 44 | 1.30 |
| 37 | Sprocket for Part 36 | 2.50 |
| 38 | Cap for Part 35 | .65 |
| 39 | Set Screw for Part 36 | .05 |
| 40 | Screw for Parts 36 and 37 | .05 |
| 41 | Key for Part 44 | .05 |
| 42 | Screw for Part 38 | .05 |
| 43 | Ball Oiler for Part 35 | .05 |
| 44 | Worm Shaft for Part 35 | 2.50 |
| 45 | Worm for Part 44 | 2.00 |
| 46 | Worm Wheel for Part 62 | 3.00 |
| 47 | Spiral Pinion for Part 62 | 2.00 |
| 48 | Screw for Part 35 | .05 |
| 49 | Taper Pin for Part 46 | .05 |
| 50 | Bushing, 1¾" long | .85 |
| 51 | Bushing 1½" long | .85 |
| 52 | Bushing, 1⅛" long | .75 |
| 53 | Brass Plug for Part 35 | .05 |
| 54 | Bushing, 3 ⅛" long | 1.25 |
| 55 | Bushing, 1¼" long | .75 |
| 56 | Filler for Part 44 | .50 |
| 57 | Collar for Part 62 | $ .50 |
| 58 | Pin for Part 57 | .05 |
| 59 | Pin for Part 45 | .05 |
| 60 | Taper Pin for Parts 47 and 81 | .05 |
| 61 | Pivot for Parts 62 and 91 | .35 |
| 62 | Rear Shaft for Part 35 | .30 |
| 63 | Drive Shaft Sleeve for Nos. 62, 91, 101 | .75 |
| 64 | Screw for Holding Part 53 in 35 | .15 |
| 65 | Bracket for Part 1 | 12.50 |
| 66 | Gib for Part 65 | .50 |
| 67 | Hone Holder for Part 65 | 3.25 |
| 68 | Bushing 2¼" long for Part 65 | 1.00 |
| 69 | Bushing, 1⅛" long for Part 65 | .75 |
| 70 | Screw for Part 67 | .20 |
| 71 | Screw for Part 65 | .10 |
| 72 | Screw for Part 82 | .05 |
| 73 | Screw for Part 65 | .05 |
| 74 | Check Nut for Part 73 | .05 |
| 75 | Screw for Part 67 | .05 |
| 76 | Dowel Pin for Part 65 | .05 |
| 77 | Dowel Pin for Part 66 | .05 |
| 78 | Taper Pin for Part 81 | $ .05 |
| 79 | Cam Shaft for Part 100 | 1.75 |
| 80 | Key for Part 79 | .05 |
| 81 | Spiral Gear for Part 79 | 1.75 |
| 82 | Hone Bracket Cap for Part 65 | .65 |
| 83 | Hone for Part 67 | 1.00 |
| 84 | Hone Pad for Part 67 | .15 |
| 85 | Hand Wheel for Part 86 | 1.35 |
| 86 | Screw for Part 67 | .75 |
| 87 | Pin for Part 85 | .05 |
| 88 | Screw for Part 89 | .05 |
| 89 | Guard for Part 65 | .75 |
| 90 | Clamp Plate for Part 67 | .25 |
| 91 | Center Shaft for Part 35 | .75 |
| 92 | Water Guard for Part 65 | .25 |
| 93 | Gear Guard for Part 81 | .75 |
| 94 | Screw for Part 93 | .05 |
| 95 | Oiler for Part 35 | .35 |
| 96 | Oiler for Part 35 | .10 |
| 97 | Pin for Parts 61 and 91 | .05 |
| 98 | Oiler for Part 35 | .10 |
| 100 | Cam | 6.00 |

| PART NO. | DESCRIPTION | PRICE EACH |
|---|---|---|
| 101 | Front Shaft for Part 35 | $ .75 |
| 102 | Bracket for Part 171 | 7.50 |
| 103 | Bushing 1½" for Part 102 | .75 |
| 104 | Bushing 2½" for Part 102 | 1.00 |
| 105 | Screw for Part 102 | .05 |
| 106 | Dowel Pin for Part 102 | .05 |
| 107 | Screw for Part 148 | .05 |
| 108 | Tension Screw for Part 212 | .05 |
| 109 | Key for Part 110 | .50 |
| 110 | Spiral Gear(Bronze)on Part 101 | 2.50 |
| 111 | Screw for Part 115 | .05 |
| 112 | Screw for Parts 113 and 114 | .05 |
| 113 | Former Shoe | 1.25 |
| 114 | Former Shoe Slide | 3.25 |
| 115 | Cover | 1.00 |
| 116 | Former Shoe Bracket | 5.75 |
| 117 | Dowel Pin for Part 116 | .05 |
| 118 | Dowel Pin for Parts 123 and 131 | .05 |
| 119 | Screw for Parts 123 and 131 | .05 |
| 120 | Screw for Parts 116 and 123 | .05 |
| 121 | Side Plate R.H. or Part 116 | .20 |
| 122 | Side Plate L.H. Part 116 | .20 |
| 123 | Guide Plate for Parts 116 and 131 | .50 |

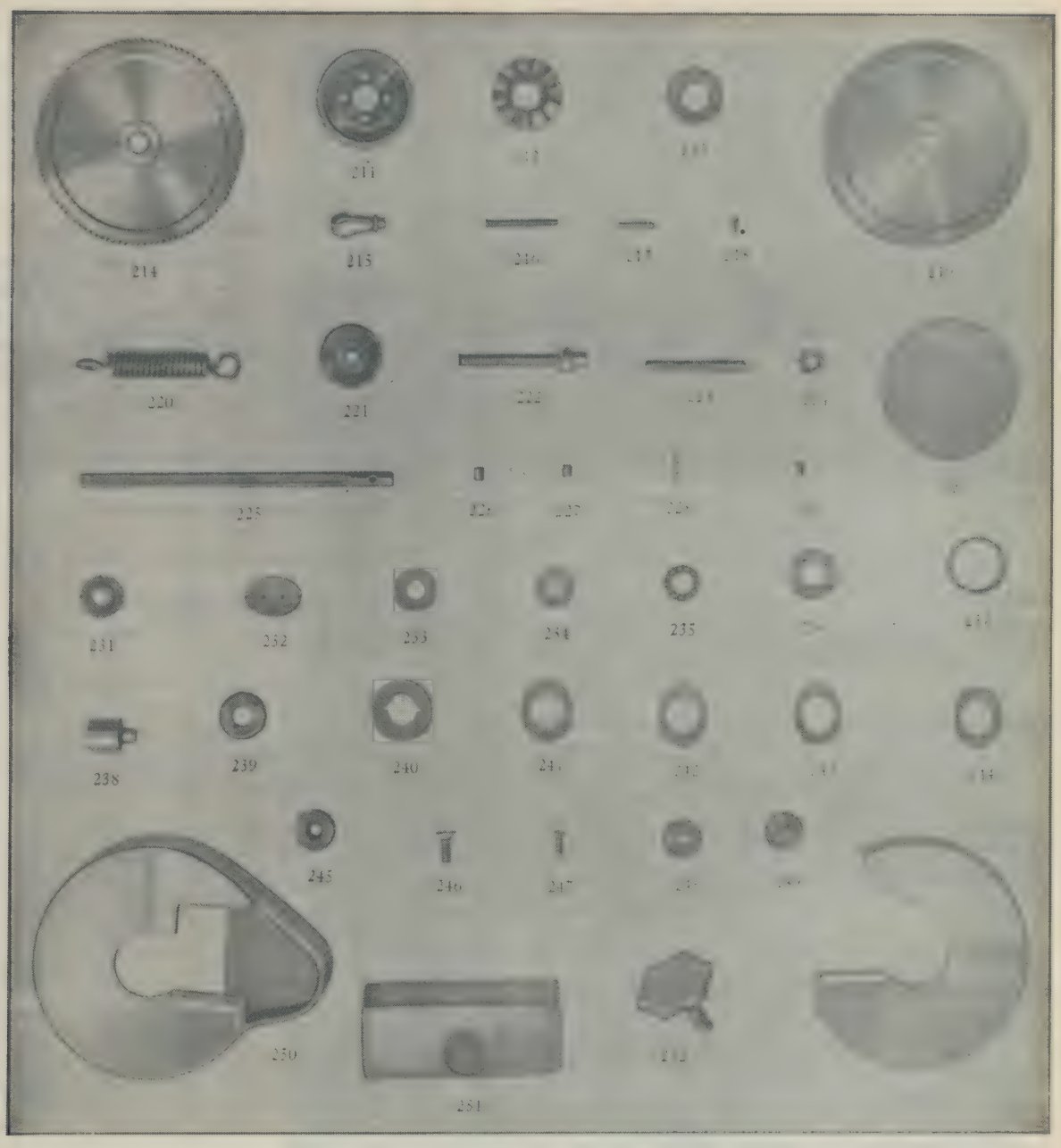
| PART NO. | DESCRIPTION | PRICE EACH |
|---|---|---|
| 124 | Lever for Part 115 | $ .80 |
| 125 | Pinion for Parts 139 in 116 | .85 |
| 126 | Hand Wheel for Part 130 | .75 |
| 127 | Indexing Plunger for Part 128 | .10 |
| 128 | Bushing for Part 124 | .35 |
| 129 | Washer for Part 130 | .15 |
| 130 | Adjusting Screw for Part 131 | 2.00 |
| 131 | Slide for Part 102 | 2.00 |
| 132 | Clamping Screw for Part 141 | .50 |
| 133 | Ball Oiler for Part 116 | .05 |
| 134 | Pin for Parts 125 and 139 | .05 |
| 135 | Spring for Part 127 | .05 |
| 136 | Pin for Parts 130 and 126 | .05 |
| 137 | Knurled Nut on Part 127 | .15 |
| 138 | Case for Part 102 | 1.50 |
| 139 | Shaft for Parts 124 and 125 | .05 |
| 140 | Screws for Part 138 | .05 |
| 141 | Micrometer Index Dial | 1.00 |
| 142 | Indexing Gear in Part 138 | 1.50 |
| 145 | Bracket for Oscillator Lever on Part 1 | 4.00 |
| 146 | Gib for Part 145 | .50 |
| 147 | Yoke for Parts 153 and 160 | 5.50 |

| PART NO. | DESCRIPTION | PRICE EACH |
|---|---|---|
| 148 | Yoke Plate for Part 147 | $ .35 |
| 149 | Gib screw for Part 145 | 05 |
| 150 | Check Nut for Part 149 | .05 |
| 151 | Hand Wheel for Part 156 | 1.25 |
| 152 | Washer for Part 147 | .25 |
| 153 | Slide for Part 147 | 2.00 |
| 154 | Cam Roll for Part 159 | 1.00 |
| 155 | Screw for Part 147 | .05 |
| 156 | Adjusting Screw for Part 147 | 1.00 |
| 157 | Lock Nut for Part 158 | .05 |
| 158 | Pivot Screw for Part 160 | .15 |
| 159 | Cam Roll Stud for Part 160 | 1.00 |
| 160 | Stone Shifting Lever | 5.00 |
| 161 | Pin for Part 151 | .05 |
| 162 | Repair Link for Part 163 | .30 |
| 163 | Driving Chain | 2.50 |
| 164 | Screw for Attaching 145 to Base | .05 |
| 165 | Dowels for Attaching 145 to Base | .05 |
| 166 | Oiler for Part 168 | .10 |
| 167 | Screw for Part 168 | .05 |
| 168 | Guard over Part 101 | 2.00 |
| 169 | Washer for Part 159 | .20 |
| 170 | Washer for Part 156 | .15 |



| PART NO. | DESCRIPTION | PRICE EACH |
|---|---|---|
| 171 | Base for Swinging Head | $ 7.50 |
| 172 | Swinging Head for Part 171 | 20.00 |
| 173 | Oiler for Part 171 | .10 |
| 174 | Lens Clamping Lever | 1.10 |
| 175 | Screw for Bushings in Part 171 | .05 |
| 176 | Worm Gear Guard | .75 |
| 177 | Bushing 5⅝" for Part 172 | 2.50 |
| 178 | Bushing 3⅜" for Part 172 | 2.00 |
| 179 | Cap for Part 172 | .75 |
| 180 | Cap for Part 172 | 1.00 |
| 181 | Screw for Part 172 | .25 |
| 182 | Oiler for Part 172 | .10 |
| 183 | Shaft for Parts 171 and 172 | 1.75 |
| 184 | Cap Screw for Parts 179 and 180 | .05 |
| 185 | Segment for Part 190 | 2.25 |
| 186 | Spiral Pinion for Part 183 | 2.00 |
| 187 | Bushing 1⅜" for Part 201 | $ .85 |
| 188 | Bushing 1¾" for Part 201 | 1.00 |
| *188A | New Style Bushing for Part 261 | 1.00 |
| *188B | Parking Nut for Part 188A | .50 |
| 189 | Bushing 1⅛" for Part 197 | 1.00 |
| 190 | Rack for Part 172 | 2.00 |
| 191 | Spiral Pinion for Part 183 | 2.00 |
| 192 | Spring Pin for Part 185 | .10 |
| 193 | Spiral Clutch Pinion | 4.00 |
| 194 | Bushing for Part 193 | .85 |
| 195 | Thrust Collar for Part 183 | .50 |
| 196 | Pin for Part 195 | .05 |
| 197 | Left Hand Lens Arbor. See also Part 258 | 3.00 |
| 198 | Extension Sleeve for Part 197 | 1.75 |
| 199 | Plug for Part 198 | $ .25 |
| 200 | Stop for Part 197 | .05 |
| 201 | Right Hand Lens Arbor See also Part 261 | 3.50 |
| 202 | Latch for Part 203 | .75 |
| 203 | Holder for Part 172 | .50 |
| 204 | Pin for Parts 202 and 203 | .05 |
| 205 | Stud for Part 174 | 1.50 |
| 206 | Keys for Part 205 | .05 |
| 207 | Nut for Part 205 | .05 |
| 208 | Key for Parts 201 and 219 | .05 |
| 209 | Screw for Part 176 | 05 |
| 210 | Screw and Washer for Parts 171 | .05 |

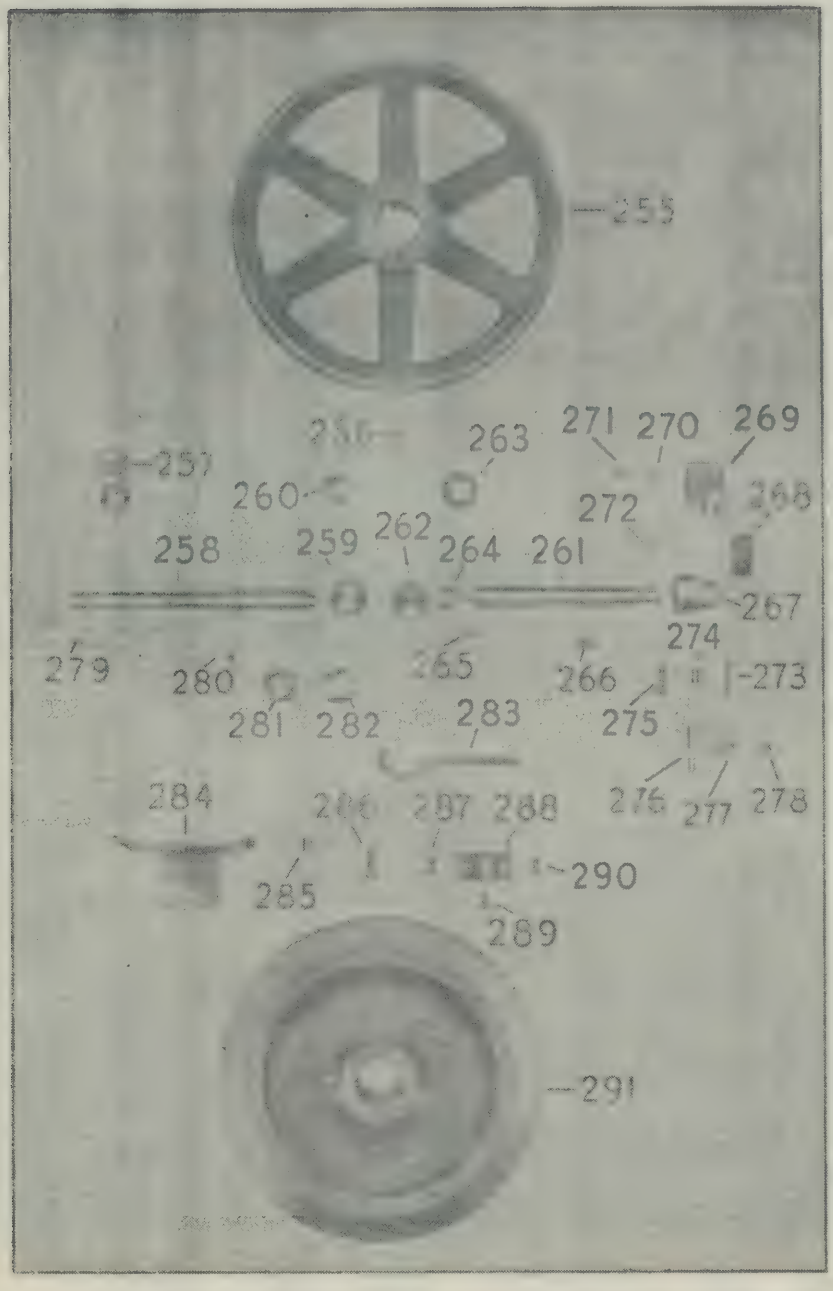
*Not Illustrated



| PART NO. | DESCRIPTION | PRICE EACH |
|---|---|---|
| 211 | Knurled head for Part 212 | $ 1.50 |
| 212 | Driving Clutch | 1.50 |
| 213 | Collar for Part 183 | .50 |
| 214 | Gear for Part 197 | 3.50 |
| 215 | Handle for Part 216 | .25 |
| 216 | Pin for Parts 215 and 211 | 10 |
| 217 | Drive Pin for Part 213 | .05 |
| 218 | Screw for Parts 211 | .05 |
| 219 | Gear for Part 201 | 3.50 |
| 220 | Tension Spring in Part 172 | .35 |
| 221 | Nut for Part 222 | 1.00 |
| 222 | Tension Spring Screw | .50 |
| 223 | Adjusting Screw for Part 171 | 20 |
| 224 | Check Nut for Part 223 | 05 |
| 225 | Rod for Parts 251 in 172 | 30 |

| PART NO. | DESCRIPTION | PRICE EACH |
|---|---|---|
| 226 | Friction Plug for Part 212 | $ .05 |
| 227 | Spring for Parts 226 in 212 | 10 |
| 228 | Pin for Parts 225 | .05 |
| 229 | Screw for Part 230 | .05 |
| 230 | Cover for Part 172 | .30 |
| 231 | Pad Holder for Part 197 | .65 |
| 232 | Pad Holder for Part 201 with Washer Part 233 | 60 |
| 234 | Rubber Pad for Part 231 per 10 | 30 |
| 235 | Thrust Bearing for Part 197 | 1.25 |
| 236 | Thrust Bearing for Part 201 | 1.50 |
| 237 | Cover for Part 236 | .50 |
| 238 | Former Holder for Part 201 | 2.00 |
| 239 | Collar for Part 238 | 1.25 |

| PART NO | DESCRIPTION | PRICE EACH |
|---|---|---|
| 240 | Round Pattern | |
| 241 | R6 Pattern | See machinery price list |
| 242 | R7 Pattern | |
| 243 | R8 Pattern | |
| 244 | R9 Pattern | |
| 245 | Washer for Part 214 | $ 30 |
| 246 | Screw for Part 247 | 05 |
| 247 | Screw for Parts 50 and 253 | 05 |
| 248 | Washer for Parts 238 | 25 |
| 249 | Thumb Nut for Part 201 | 25 |
| 250 | Guard for Part 214 | 2.00 |
| 251 | Weight for Part 225 | 1.00 |
| 252 | Hand Wheel for Part 251 | 50 |
| 253 | Guard for Part 219 | 1.00 |




*The parts shown on this page are for the M840A Edger only. Those shown on the preceding pages are also used on the M840 Edger.*

| PART NO. | DESCRIPTION | PRICE EACH |
|---|---|---|
| 255 | V-Belt Pulley | $ 4.50 |
| 256 | No. 520 Gits Oiler | .10 |
| 257 | Thrust Washer | See No. 235 |
| 258 | Left Hand Lens Arbor See also part 197 | 1.75 |
| 259 | Left Hand Pad Holder | 1.00 |
| 260 | Pad Used on M840 | .06 |
| 261 | Right Hand Lens Arbor See also part 201 | 1.75 |
| 262 | Right Hand Holder | 1.00 |
| 263 | Pad (Vellumoid) | .06 |
| 264 | Collar | 1.00 |
| 265 | 1/16" Dia. Pin 5/8" Lg. | .05 |
| 266 | No. 4 Woodruff Key | $ .05 |
| 267 | Former Holder | 2.50 |
| 268 | Former Shoe | .75 |
| 269 | Former Shoe Bracket | 1.75 |
| 270-1 | No. 8-32Px3/8" Lg. H.S.S. & Lock Nut | .10 |
| 272 | No. 4-36P x 7/16" Lg. F.L.S. | .10 |
| 273 | .093 Dia. Pin 5/32" Lg. | .05 |
| 274 | No. 10-24P x 3/8" Lg. H.S.S. | .05 |
| 275 | No. 10-25P x 3/4" Lg. F.H.S. | .05 |
| 276 | 1/8" Dia. Pin 1 1/8" Lg. | .05 |
| 277 | Washer | .05 |
| 278 | Lock Washer | .05 |
| 279 | 1/8" x 3/16" Pin | $ .05 |
| 280 | 1/4"-20P x 1/4" H.S.S. | .05 |
| 281 | Packing Nut | .50 |
| 282 | Pad | .05 |
| 283 | Spanner Wrench | .50 |
| 284 | Guard | .35 |
| 285 | 1/4" Dia. Plug 3/8" Lg. | .10 |
| 286 | 1/4"-20P x 3/4" Lg. F.L.S. | .05 |
| 287 | No. 10-24P F.L.S. | .05 |
| 288 | Diamond Holder | .75 |
| 289 | Brass Screw | .05 |
| 290 | No. 10-24P F.L.S. | .05 |
| 291 | Flange | 6.00 |

## EDGE GRINDING

### DIRECTIONS FOR OPERATING THE SHURON 66-A EDGER

RIMLESS EDGE GRINDING MACHINE - All this painstaking performance--developed skill and hard work--of grinding the edges of lenses by hand brought forth the "automatic edging machine" (rimless). The earliest of these was a simple contrivance to clamp the lens between two spindles and to rotate it against the face of a grindstone. There was more to it than just that. There was the matter of size, of shape, and of oscillation, to produce a machine-ground lens equal in accuracy and beauty of workmanship to a band-ground lens. Oscillation is necessary to prevent the lens from grinding in the same path and forming grooves in the face of the grindstone.

Gears, belts, chains and cams were employed to produce the mechanical movements necessary to duplicate the hand job. None of these were any too good, because of wear, back-lash, and jumpy operation. These faults resulted in chipped lenses, "bumpy" shapes, "off-axis" grinding, and "wavy" edges.

The machine has a pendant carriage so delicately balanced that the thinnest lens may be ground without chipping. Incidentally, the use of weight in connection with the pendant carriage to regulate the pressure of the lenses against the stone enables the operator to estimate the pressure and instantly adjust it to a nicety and insure a uniform pressure at all times.

The carriage of the "66" Grinder oscillates instead of the stone. It is mounted on the same table slide with the truer so that the surface of the stone is always true with relation to the lenses in the machine. The slide is completely enclosed and submerged in oil, the oil being covered to keep out dirt.

All bearings are completely protected from ground glass, grit and refuse water, and all gears are entirely enclosed and nearly all run in an oil bath. These two features insure perfect adjustment at all times and a longer life for the machine.

The oscillation is uniform, smooth and positive, and is instantly adjustable in either direction while the machine is in operation. Thus the whole surface of the stone is utilized and the wear distributed equally whether one or six lenses are being ground.

The truing device is on the front of the machine where it is readily accessible. When truing with a diamond, the diamond may be automatically passed clear out of the grinding wheel on both edges.

The "66" Grinder is equipped with a very quick and accurate lens centering and clamping device and once in the machine the lenses are securely and positively held by direct spring pressure. Clamping and unclamping is done instantly with a lever.

As the carriage is pendant, the top of the grinding wheel moves toward instead of away from the operator, throwing the refuse water down into the trough. The trough may be easily cleaned by means of an opening in front.

FIGURE 1.

The "66" Grinder is quickly adjusted to grind any size lens, and formers of any shape are easily attached.

The lens clamp lever 2172 (see Figure 3) operates a positive cam arm which in turn pushes against a spring under compression--thus the operation is instantaneous and positive, yet the lenses are not held in a clamp so rigid as to endanger breakage.

The gears and spindles in the carriage are packed in grease. Enough of this should be added through the grease fittings No. 1854 on top of carriage, so that a little will keep working out on the spindle bearings behind the pad holders. This will insure that no grit will be working in at these points.

The bearings of the slide table are submerged in machine oil. This is supplied through the cup No. 2260 at right front of slide and the oil level should be about one-half way up in the cup. The slide is operated by a cylinder and piston. Oil is pumped into first one end of this cylinder and then the other by a rotary pump having a reversing valve. This valve is reversed by tipping pin No. 1485, in front of slide base, one way or the other. The position and amount of oscillation of slide table can be controlled by trip screws No. 143 while the machine is either running or idle.

The hone 2313 on the top of the stone is not for the purpose of truing the stone but simply to keep the stone in good cutting condition. The screw holding this hone should be tightened down just enough to hold it steady.

The hone 2240 on carriage slide is for truing the stone and should be used at the first indication of a facet or chatter on the edge of the lens ground as this condition is caused by the stone becoming out of true. It will be found that, due to the upper hone keeping the stone surface in good cutting condition, it will stay

true much longer than when this upper hone is not used. Keeping hone No. 2240 against the stone lightly at all times is advised. At any rate, keep the stone true.

FIGURE 2. No. 2355 Centering Attachment for the Shuron No. 66-A Rx Rimless Edge Grinder.

To place a lens in the machine when using centering attachment (known as No. 2355), Figure 2, pick it up in such a way that the two pads AA can be closed toward each other, thus opening up the clamping jaws. Place the Head Pad holder B on the small locating pins. There are two of these Pad Holders furnished with the machine, a thick one, No. 2227, for one or two lenses, and a thin one, No. 2356, to be used if more than two lenses are to be edged at once. Locate the lens or lenses in the proper position on the Pad Holder. A small hole in the center of the Pad Holder enables the operator to center the lens accurately, while two small holes in the jaws of the attachment serve as guides for correct axis position. Releasing the pressure on pads AA allows the jaws to clamp the lens, after which it may be rechecked to be sure that it is correctly placed in the attachment. Peephole bar C may be pushed to one side if the operator does not care to see it, but for accurate centering, it should be used, as it ensures the lens being viewed from the true vertical point over the center of the lens. If the lens is placed while it is viewed at an angle, it will cause the lens to be decentered. (This fact is true of all centering attachments, but all of them do not have means whereby the correct position can be known). After the lens has been clamped and checked for correct positioning, swing bar C to one side and place lens in machine by slipping the Pad Holder B over its locating pins on the Head Spindle of the machine. Clamp the lens in machine by pushing lever No. 2172 to the left. Then by again applying pressure to pads AA, the centering attachment may be removed. To start the lens revolving, raise operating lever No. 666 to the upright position.

To obtain the size of lens desired to be ground, turn the index wheel 1320 until the graduation on the index indicating desired eye size is in line with the zero mark on machine. Turning the wheel to the right decreases and to the left increases the size of lens ground.

The lens is held against the stone by means of weight No. 2304. Pressure may be increased by sliding the weight No. 2304 forward on rod No. 2306. For grinding a single lens only a slight pressure is needed. Excessive pressure tends to roughen

stone and hence to chip lens. The lens should be allowed to grind until former 651 rubs on the contact plate throughout one or two complete revolutions.


FIGURE 3. The Shuron No. 66-A Rimless Edge Grinder.

If it should be found that the length of lens ground does not correspond to the reading on the index dial 1320, adjust dial as follows:

Turn screw No. 817 counter-clock-wise about one turn, being careful not to let wheel No. 1320 turn. Now hold wheel No. 1320 steady while the graduation, corresponding to the size that lens measured, corresponds with the zero line on machine, then tighten screw No. 817 by turning it clock-wise. This will bind the graduated ring to the knurled one, making them move as one.

If it is desired to move the machine a little closer to the stone because of wear, with hone No. 2240 against stone, loosen the clamp screws No. 105 up a little and turn back the truer slide, letting the whole unit slide down the desired amount. Then again tighten screws No. 105. After an adjustment of this kind, it will be necessary to readjust index dial.

If it is found that the machine is grinding the lens a little off axis, this can be corrected by tipping the contact-plate (2243) a little in the direction opposite to that in which the axis is off. The steel clip on the face of this plate is for convenience in taking care of wear without disturbing the axis adjustment.

## EDGE GRINDING

### DIRECTIONS FOR OPERATING THE SHURON 77-A EDGER

When you receive your new 77-A Edger unpack it carefully and check the following accessories:

| | |
|---|---|
| 2 Wrenches | 1 Thick regular pad holder |
| 1 Lens clamp | 1 Thin regular pad holder |
| 2 Screwdrivers | 1 Small Round Regular pad holder |
| 6 Patterns | 10 Rubber pads |
| 1 Oil can | 10 Rubber washers, thick |

The machine itself is 13" wide, 17" deep and 18" high and weighs 90 pounds. With motor plate it is 23 inches deep and with motor added will weigh about 120 pounds according to motor construction.

The edger may be placed on any bench and operated by a motor placed on a special adjustable plate at the rear of the edger or it may be belted down through the bench to a motor under the bench.

The motor should be of 1/4 horse power and 1140 revolutions per minute. The motor pulley should be 3 1/8" in diameter and made for 7/16 Vee leather belt. Correct stone speed is 530 revolutions per minute.

If your own motor is installed or this machine is connected to a line shaft, these instructions should be followed:

*To check speed of stone count revolutions of shaft Q. Stone turns 12 times as fast as this shaft. This shaft should turn 44 times per minute which will give a stone speed of 530 revolutions per minute.*

The rotation of the stone is forward, the top of the stone turning toward the front of the machine.

Before attempting to grind lenses be sure that the sponge in the round removable sponge holder, at the rear of the stone, is in position. There should also be a sponge in the clip over the truer stick. Provide water in receptacle on top of machine and connect tell-tale light connection with 110-volt current.

The machine has been well oiled and run in on the test line. The main stone bearings will need oil once every two weeks. The head will need oil once a month and the gear box at the right end of the stone arbor will need oil once every two weeks. Two or three drops of good machine oil in each cup is all that is necessary at one oiling. Place a drop of oil occasionally in oil hole on truer feed wheel.

Lenses have been ground on this stone for three days, so it is now trued and ready to go to work.

To check for correct position of sizing dial, set at 40 mm. This should bring the small white pin in the dial flush with the top of the feed screw. To set size, turn dial to one size smaller than required and then turn dial clockwise to size desired.

The regular drop-shape pad holder is 37mm. long and should not be used for lenses under 38 mm. A small round pad is supplied for the small size grinding, and a regular drop-shape thin pad for thick lens grinding or for pairs of lenses, both of these pads being standard equipment with the 77-A.


FIGURE 4.

A. Lens clamping wheel.
B. Rotation engaging wheel.
C. Lens positioning pointer.
D. Sizer dial.
E. Lens pad holders.
F. Post to tip-up head spindle.
G. Pressure weight.
H. Lens former.
I. Truer feed wheel.
J. Truer lever.
K. Water dip control.
L. Peep sight.
M. Carriage raising lever.
N. Carriage lever latch.
O. Stone adjusting nut for sizing lens.
P. Lens clamp to pad holder.

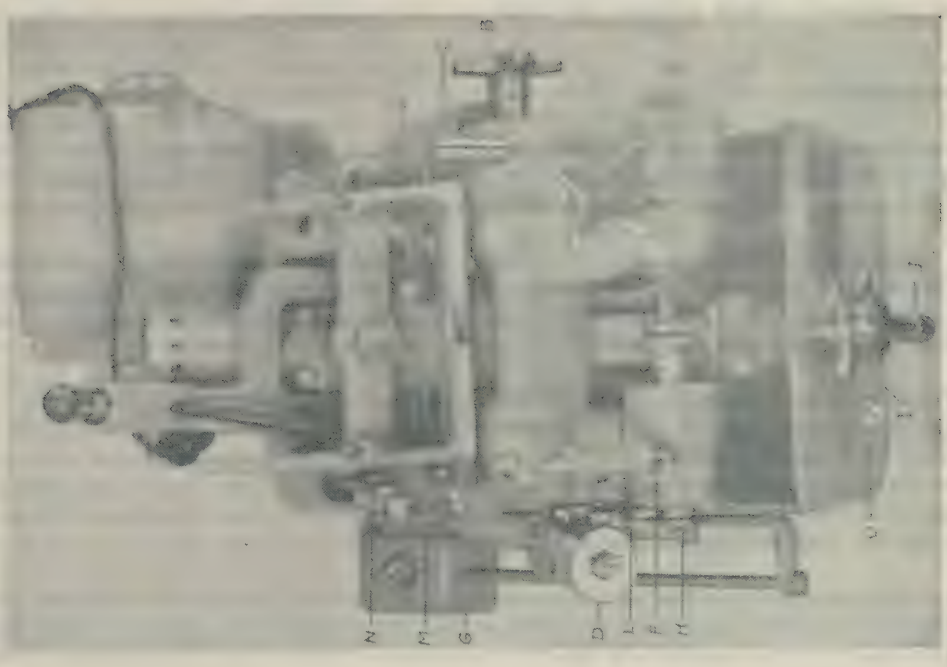


FIGURE 6.

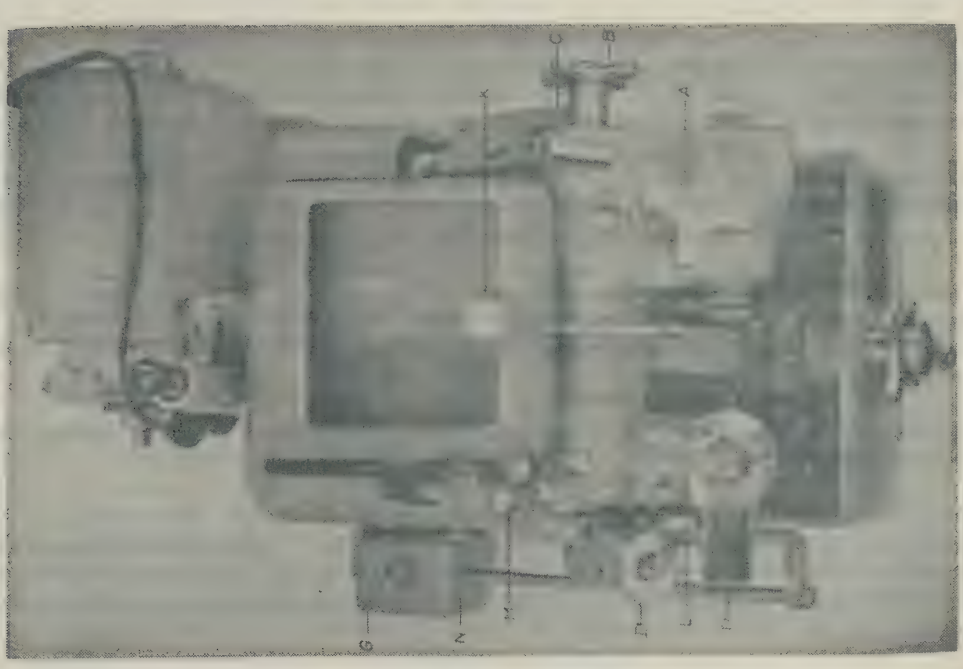


FIGURE 5.

## EDGE GRINDING

### TO INSERT A LENS FOR GRINDING

Place former on machine at point H (Figure 6)(if drop-shape, see that bottom of former is on the same side as bottom of drop shape pad holder). Set sizer dial (D) for size required. Move weight (G) back to rear of slide.

Move lever (M) back until latch (N) catches, to hold carriage up away from the grinding position.

Turn hand wheel (A) to left with right hand as far as it will go--which unlocks the head spindle--and hold in this position. With left hand swing post (F)(Figure 6) to left which will tip up the head spindle to its vertical position.

A perfect view of the new protractor pad holder is presented. Pull out hand wheel (B) to the extreme right and turn. This will revolve the pad so that lines may be placed in 180° meridian. Be sure that the drop-side of the pad protractor coincides with the drop on your pattern if you are using a drop shape.

Place lens on pad with convex side down, using the right hand. With the lens clamp (P) held in the left hand next to the carriage and parallel to the 180° lines on the pad protractor, place the two top fingers of the clamp holder over the lens from the left, and slide the bottom of the clamp on to the square milled space on the under side of the pad holder. Release pressure on lens clamp and lens will be held on to the pad holder by the clamp.

The lens should now be moved so that the cutting line will fall on the white space located between the two black lines on the pad holder, and so that the center mark will fall in the center of the white square located in the middle of the pad.

By moving the lens slightly any possible error in position of axis and center can be easily checked.

With right hand turn lens clamping wheel (A) about a quarter turn to left to unlock the head spindle and with left hand on post (F) tip the head spindle, with its lens and lens clamp, down to the right as far as it will go, which will bring the head spindle in line with the tail spindle and pad. Now turn the lens clamping wheel to the right, which will bring the tail spindle and lens pad up to the lens. Set clamping pressure with lens clamping wheel and REMOVE THE LENS CLAMP FROM THE LENS AND MACHINE. Failure to remove lens clamp will cause damage for it is impossible to rotate the lens clamp on the lens spindle.

With right hand push wheel B in toward the carriage as far as it will go. This will engage the gears that turn the spindle for lens grinding. DO NOT OPERATE UNLESS *FULLY* engaged. The lens will now be turning at the rate of 2 1/2 revolutions per minute.

With left hand on lever (M) release latch (N) and let carriage down carefully, until the lens meets the stone.

Watch the travel of the lens toward the edge of the stone and as the lens approaches the stone edge set it back, if necessary, with positioning pointer (C). Once the position has been set it will not be necessary to touch the positioning pointer again until you have changed to a different curvature of lens, or to a pair of lenses.

Move weight (G) forward slightly on the slide to increase grinding pressure. Use this weight carefully for it increases the pressure very fast.

Be sure of ample water supply and check sponges. Now as the lens nears

completion it will be noted that the tell-tale light will begin to light. A steady light through one revolution of the lens shows a finished job down to the size that was set on the sizing dial. Move the weight (G) to the forward extremity for the last revolution of the lens.

To remove lens from machine first slide weight back to rear and push back on carriage lever (M) until latch (N) engages and holds carriage out of grinding position. Pull out hand wheel (B) to stop spindle revolving. With left hand take hold of lens and with right hand turn lens clamping wheel (B) to the left which will bring back tail spindle and pad so lens may be removed.

To check the accuracy of size in grinding, attach the lens clamp to the lens and pad holder AFTER REVOLVING OF SPINDLE HAS BEEN STOPPED. Then release pressure on hand clamping wheel (A) and tip the head spindle to a vertical position. The lens may now be viewed and measured and, if necessary, be replaced in grinding exactly as it was before.

To true the stone hold lever (J) with left hand and turn hand wheel (I) to the right until the carborundum stick engages the stone. Now oscillate the lever (J) back and forth, which will give a new flat surface on the stone (be sure not to run carborundum stick off the edge of the stone.) When truing is completed, be sure to back off on wheel (I) to disengage carborundum stick from stone.

To change axis turn the brass screw on the back of the contact plate with a screwdriver. Turning left will shift lens axis to right. Turning right will shift lens axis to left.

If the lens tends to jump ahead on odd shape lens corners when in contact with the stone, tighten down slightly on the screw on top of post (F). This will put a brake on the head spindle which may become necessary because the ball bearing construction in the head turns very freely.

If the size of the lens is small, turn screw (O) to left, which will lower the stone carriage assembly, thus making the lens larger. If the lens is large, turn the screw to the right.

To put more tension on clamping wheel (A) simply turn down slightly the two screws on the plate directly under the clamping wheel.

The water container on top of the machine is constructed with a drip control (K)(Figure 5) which must be removed when water is piped from city supply. The drip from the supply pipe will then go through the container and on to the stone through the movable spout.

Do not attempt to pipe water direct to the stone as the spout on the water container is designed to follow the lens oscillation, which decreases the tendency toward water marks.

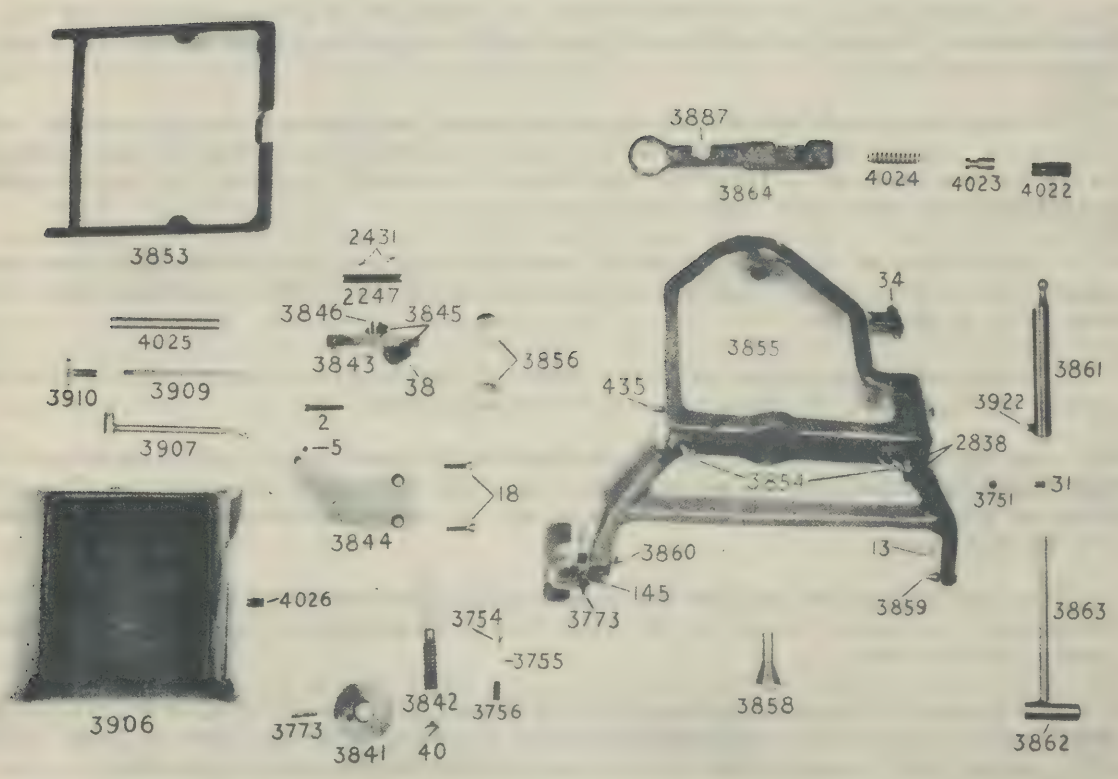
To replace or adjust carborundum stick shut off power first, then tip up the head. The truing lever can now be rotated to bring the stick upside down, which will expose its clamping screws in an accessible position for adjustment.

After all, no grindstone--or machine--is better than the condition of its working face. "Truing" and "honing" are essential. It is true that large "stones" will "last" longer. They will require reconditioning less often. But the larger the "stone", the longer "time" will be consumed in bringing it back to proper working

condition. Because workmen are so notoriously prone to "put off until tomorrow", due to press of other work, the apparently non-productive job of truing grindstones, they are sadly neglected. In the meantime, the surface becomes "glazed", ridges appear at the edges, and productive efficiency is progressively lowered.

Actually no "machine" grindstone should be used as a "handstone". No hand grinding should be done on it! Such work tends to form "grooves" and low places on the "face". For the benefit of better results in "machine" grinding use an exclusive handstone for "hand work" and for "touching off" the corners of lenses ground in edging machines. This job should be done neatly. There is nothing more indicative of poor workmanship than a "rimless" edge that has had the "corners" edged off in a "sloppy fashion".

## SPARE PARTS LIST FOR "SHURON 77-A EDGING MACHINE

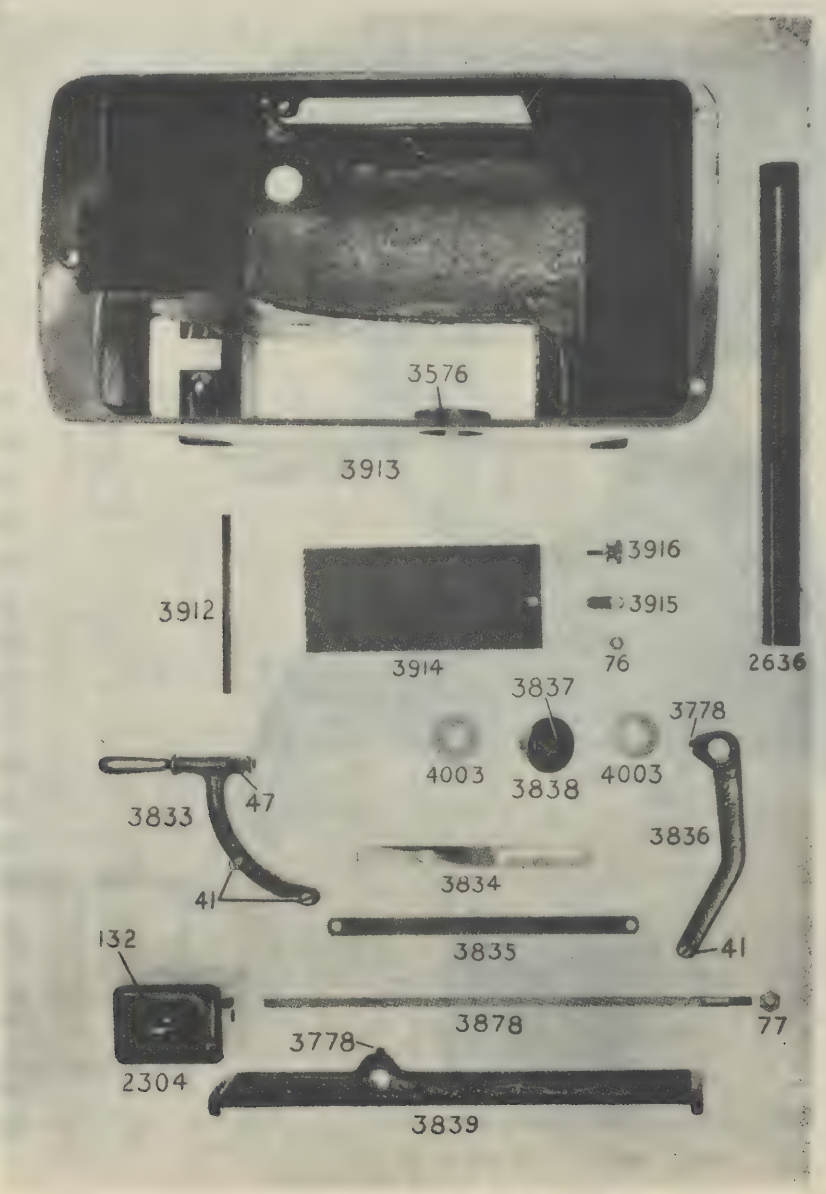


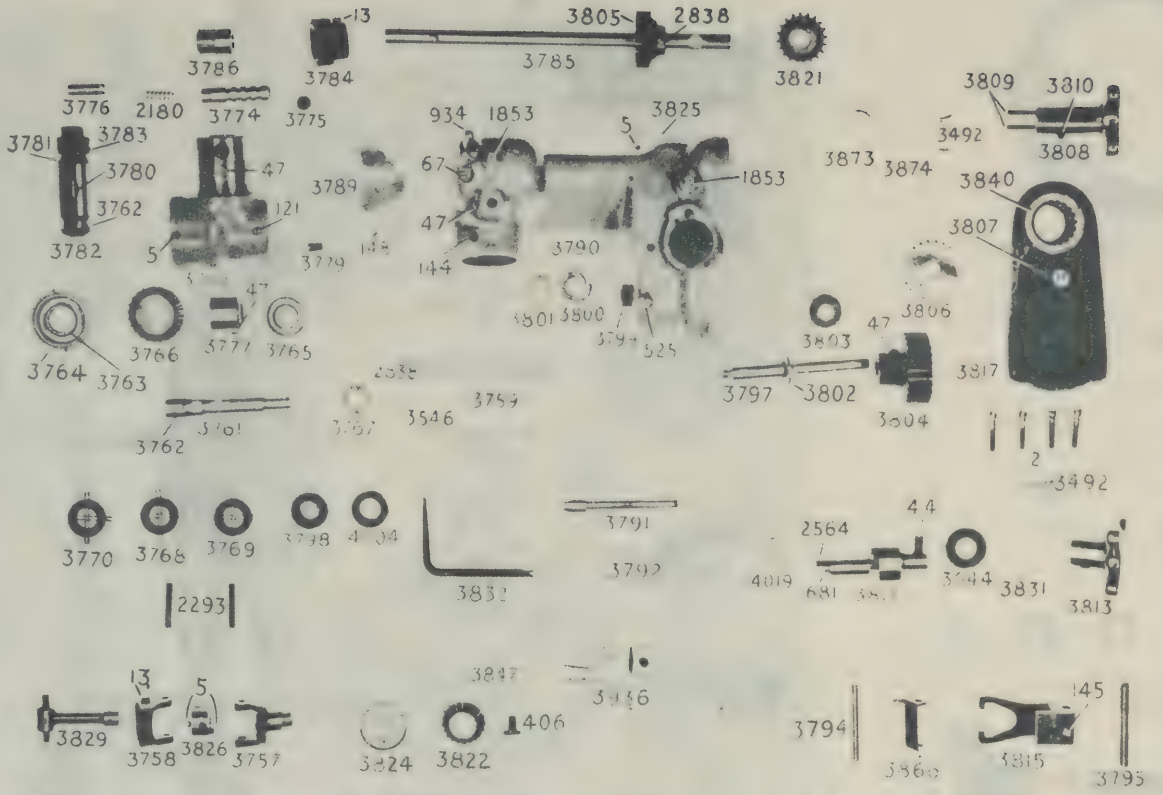

| Stock No. | DESCRIPTION |
|---|---|
| 76 | Nut 10-30 |
| 681 | Pin ⅛" x ⅜" |
| 3917 | Hood—Right Side (681) |
| 3918 | Hood—Left (681) |
| 3919 | Hood Push Stud |
| 3921 | Hood Clamp Nut |

| Stock No. | DESCRIPTION |
|---|---|
| 5 | Screw 10-30 x 3/16" Hdls. |
| 13 | Screw 1/4-30 x 5/8" Hdls. |
| 17 | Screw 1/4-30 x 1/4" Hdls. |
| 53 | Screw 10-30 x 1/2" Hdls. |
| 63 | Screw 5-40 x 1 3/8" Fil. |
| 66 | Screw 1/4-20 x 1 1/4" Hex. |
| 114 | Screw 1/4-20 x 1/2" Set |
| 116 | Screw 1/4-20 x 5/8" Csk. |
| 121 | Screw 10-30 x 1/4" Hdls. |
| 435 | Screw 10-30 |
| 1857 | Zerk Fitting 1/4-32 Ell. |
| 2322 | Screw 1/4-30 x 5/8" Hdls. |
| 3848 | Switch for Pilot Light |
| 3849 | Nut 5-40 to Clamp Switch |
| 3879 | Pulley for Stone (13) |
| 3880 | Stone Arbor Only |
| 3881 | Stone Center |
| 3882 | Stone Clamp Ring |
| 3883 | Bearing for Stone—Right |
| 3884 | Bearing for Stone—Left |
| 3885 | Felt for Stone Bearing |
| 3886 | Felt Packing Ring |
| 3887 | Oil Cup. Hinged 5/16" |
| 3890 | Yoke for Stone (4/66-2/114-116-121-3892-3893 3900-4018) |
| 3892 | Cap for Bearing—Right (2322) |
| 3893 | Cap for Bearing—Left |
| 3894 | Worm on Stone Arbor |

| Stock No. | DESCRIPTION |
|---|---|
| 3895 | Gear for Worm No. 3894 (13) |
| 3896 | Vertical Shaft—Lower |
| 3897 | Gear on Vertical Shaft (47) |
| 3898 | Worm for Gear No. 3897 |
| 3899 | Shaft for Worm No. 3898 |
| 3900 | Bearing for Shaft No. 3899 |
| 3901 | Screw to Adjust Stone Yoke |
| 3902 | Screw Head (3901) |
| 3903 | Screw Nut Stud |
| 3904 | Screw Cover Rubber Tube |
| 3905 | Fiber Washer for Stone Arbor |
| 3911 | Leather Friction Pad for No. 3903 |
| 3923 | Lamp Bulb |
| 3924 | Lamp Socket Adjustment |
| 3925 | Lamp Socket Assembly (3924-3927) |
| 3926 | Lamp Socket Casing |
| 3927 | Lamp Socket Post (⅛" Nipple) |
| 3928 | Cap for Casing 3926 |
| 3930 | Connection for Lead-in Wire |
| 3931 | ⅛" Bushing for Wire |
| 4018 | Oilite Bushing for Shaft (3896) |

| Stock No. | DESCRIPTION |
|---|---|
| 8 | Screw ¼″-30 x 1¾″ Set |
| 18 | Screw 10-30 x ⅝″ Fil. |
| 31 | Screw ¼″-20 x ¾″ Fil. |
| 47 | Screw ¼″-30 x ¼″ Hdls. |
| 76 | Nut 10-30 |
| 97 | Screw $\frac{5}{16}$″-18 x ½″ Set |
| 112 | Screw $\frac{5}{16}$″-18 x ⅞″ Hex. |
| 121 | Screw 10-30 x ¼″ Hdls. |
| 161 | Wrench ¼″ x $\frac{5}{16}$″ |
| 830 | Screw 10-30 x $\frac{9}{16}$″ Fil. to Clamp Carborundum Stick |
| 954 | Plate to Clamp Carborundum Stick |
| 2240 | Carborundum Stick for Truer |
| 3554 | Hex. Wrench for Screw No. 3778 |
| 3751 | Friction Leather $\frac{3}{16}$″ |
| 3850 | Cleat for Switch Wire (18) |
| 3857 | Cone Bearing, Lower (8) |
| 3867 | Main Frame, Upper (47-3/97) |
| 3868 | Truer Bearing Bushing |
| 3869 | Truer Star Wheel (121) |
| 3870 | Truer Stem |
| 3871 | Truer Lever (121) |
| 3872 | Truer Lever Retaining Screw |
| 3875 | Sponge Tube—Outer |
| 3876 | Sponge Tube—Inner (3877) |
| 3891 | Stud Pivot for Stone |
| 3919 | Hood Push Stud |
| 3920 | Hood Pull Stud |
| 4005 | Sponge, Rear |
| 4006 | Sponge, Truer |
| 4007 | Screw Driver $\frac{3}{16}$″ |





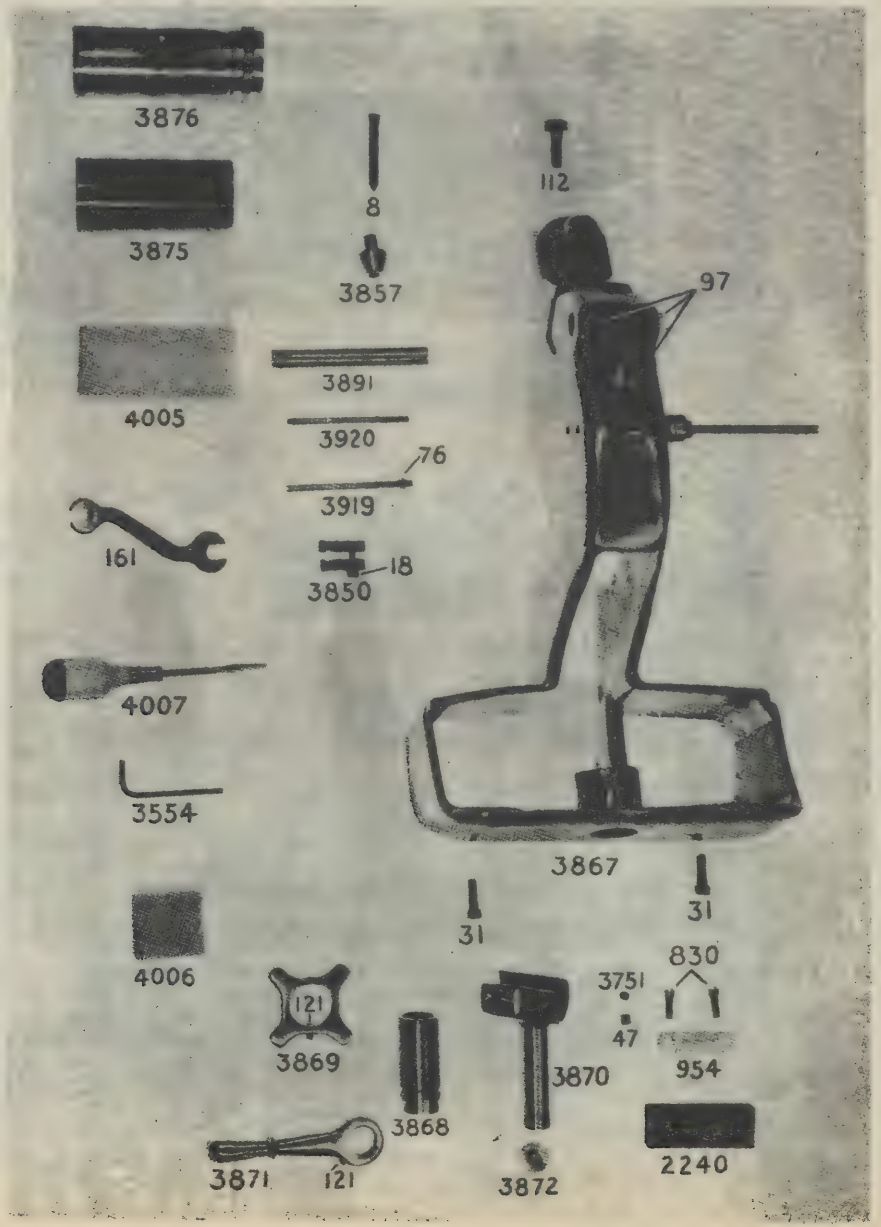

| Stock No. | DESCRIPTION |
|---|---|
| 2 | Screw 10-30 x 7/8" Fil. |
| 5 | Screw 10-30 x 3/16" Hdls. |
| 13 | Screw 1/4-30 x 1 3/4" Set |
| 44 | Screw 1/4-30 x 1 1/4" Hdls. |
| 47 | Screw 1/4-30 x 1/4" Hdls. |
| 67 | Screw 10-30 x 5/16" Hdls. |
| 121 | Screw 5/16"-18 x 7/8" Hex. |
| 144 | Screw 1/4-30 x 3/16" Hdls. |
| 145 | Screw 1/4-30 x 3/8" Set |
| 148 | Screw 5-40 x 3/16" Fil. |
| 233 | Pin 3/16" x 1 1/2" |
| 406 | Screw 1/4"-30 x 3/8" Fil. |
| 525 | Oil Hole Cover 5/16"-30 |
| 681 | Pin 1/8" x 3/8" |
| 934 | Pin 1/4" x 1 3/8" |
| 1853 | Alemite Oiler 1/4"-32 |
| 2293 | Pin 3/16" x 1 3/16" |
| 2564 | Pin 3/16" x 3/4" |

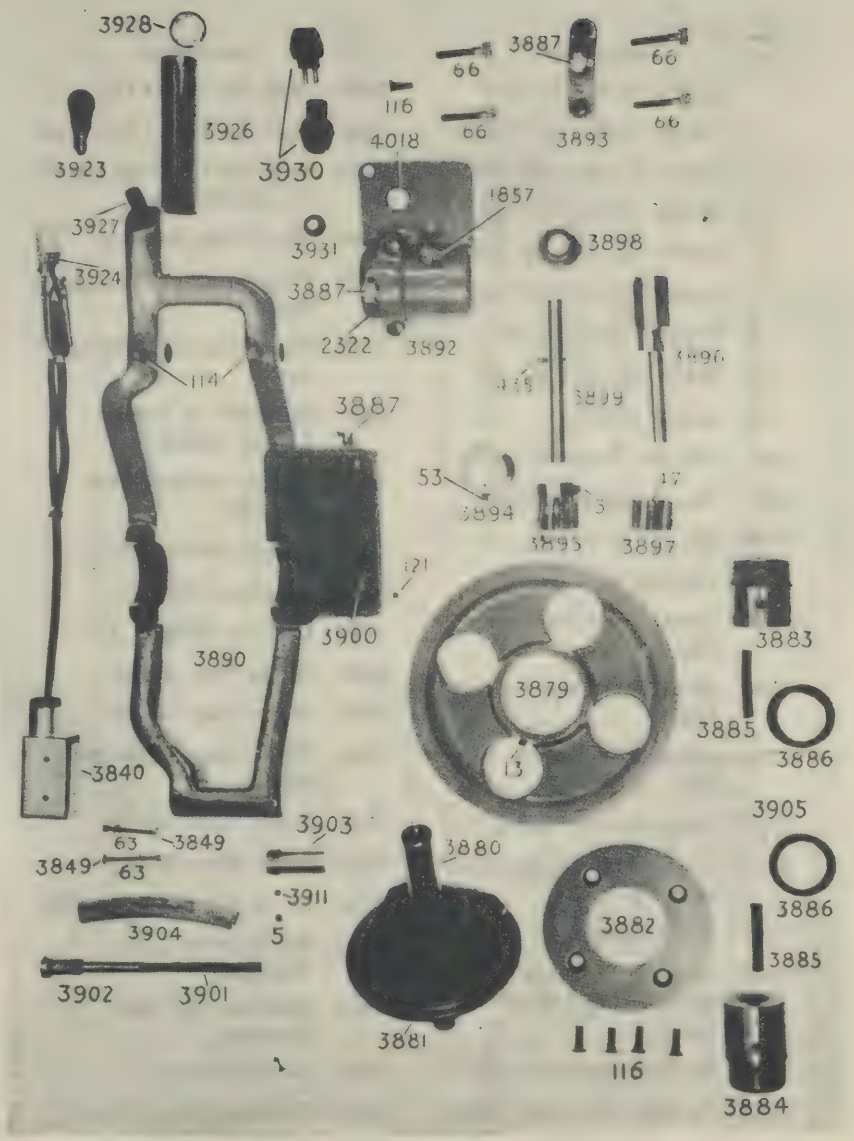
| Stock No. | DESCRIPTION |
|---|---|
| 2838 | Pin 1/8" x 13 16" |
| 3044 | Fiber Washer 1/2" x 11/8" |
| 3492 | Screw 5-40 x 9 32" Fil. |
| 3546 | Spring to Retain Former |
| 3757 | Universal Joint, Upper |
| 3758 | Universal Joint, Lower |
| 3759 | Block to Retain Former Spring |
| 3760 | Housing for Head Spindle (5-47-121) |
| 3761 | Head Spindle (3762) |
| 3762 | Key Pin for Head Pad Holder |
| 3763 | Front Bearing Head Spindle |
| 3764 | Bushing for Bearing No. 3763 |
| 3765 | Rear Bearing for Head Spindle |
| 3766 | Gear for Head Spnd. (47-3772) |
| 3767 | Collar for Former Pins (2/2448) |
| 3768 | Head Pad Holder Reg. (976) |

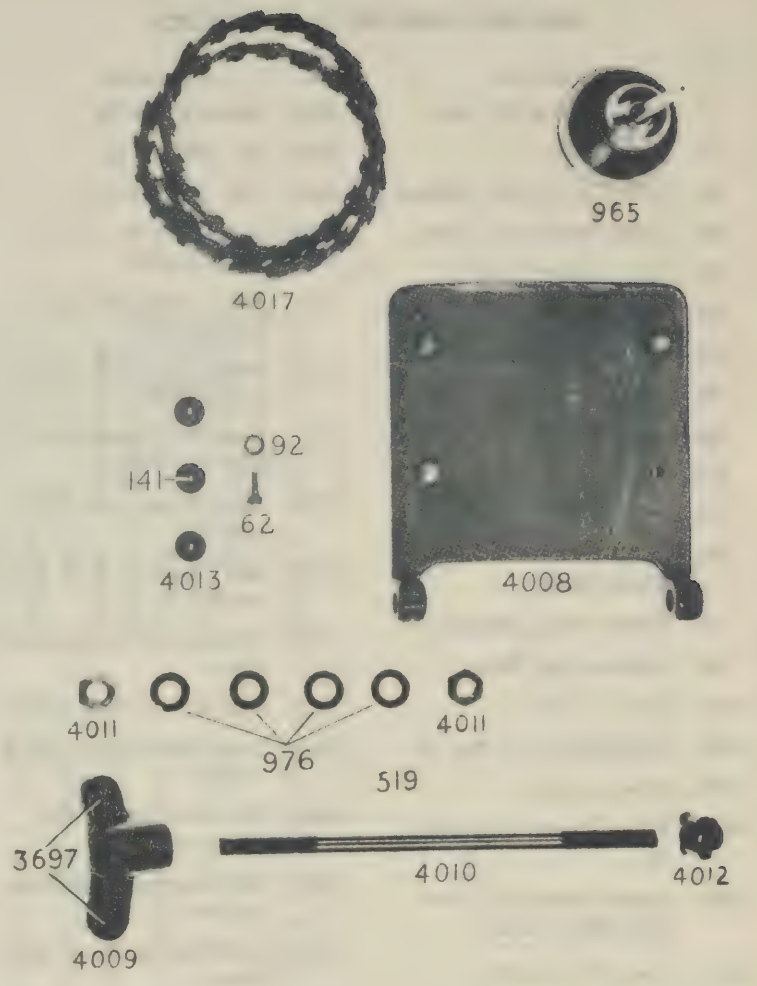
| Stock No. | DESCRIPTION |
|---|---|
| 3769 | Head Pad Holder Rd. (976) |
| 3770 | Head Pad Holder Short (976) |
| 3774 | Handle for Tip-up |
| 3775 | Friction Adjusting Screw |
| 3776 | Friction Plug |
| 3777 | Friction Drum (47) |
| 3779 | Stud for Tip-up Stop |
| 3780 | Cross Shaft for Head Spindle |
| 3781 | Bearing for Cross Shaft |
| 3782 | Gear, Bevel for Cross Shaft (3762-3771-3780) |
| 3783 | Gear, Spiral for Cross Shaft |
| 3784 | Gear, Spiral for Back Shaft (13) |
| 3785 | Back Shaft (2838-3805) |
| 3786 | Bearing for Left End Back Shaft |
| 3789 | Cover for Tip-up Slot (3787) |

| | |
|---|---|
| 3790 | Carriage Center (2/5-47-67-144-934-3825) |
| 3791 | Bolt to Lock Tip-up End |
| 3792 | Spring for Lock Bolt |
| 3794 | Stud for Bell Crank |
| 3795 | Stud for Clamp Fork |
| 3797 | Tail Spindle |
| 3798 | Pad Holder for Tail Spindle (976) |
| 3799 | Front Bearing for Tail Spindle |
| 3800 | Packing for Tail Spindle |
| 3801 | Packing Nut for Tail Spindle |
| 3802 | Thrust Cone |
| 3803 | Thrust Cup Tail Spindle (1253) |
| 3804 | Gear on Tail Spindle (47) |
| 3805 | Gear to Drive Tail Spindle (3819) |
| 3806 | Gear Intermediate for Tail Spindle |
| 3807 | Stud for Intermediate Gear |
| 3808 | Clutch Star Wheel (3810) |
| 3809 | Clutch Pin |
| 3810 | Screw to Retain Clutch Wheel |
| 3812 | Lens Clamp Eccentric (672-681-2564) |
| 3813 | Lens Clamp Star Wheel |
| 3815 | Hub for Clamp Fork (145-2/2948-3811) |
| 3817 | Carriage End Cover (3807-3840) |
| 3821 | Gear, Mitre, on Back Shaft (3823) |
| 3822 | Gear, Mitre, on Vertical Shaft (3823) |
| 3824 | Ball Bearing for Mitre Gear |
| 3825 | Stop Screw for Bearing No. 3824 |
| 3826 | Universal Joint Center (2/5) |
| 3827 | Universal Joint Complete (2/2293-3757-3758-3826) |
| 3829 | Tee Head for Shaft (3828-1078) |
| 3831 | Friction Clip for Eccentric No. 3812 (3816) |
| 3832 | Eye Piece |
| 3840 | Ball Bearing Cup for Back Shaft (3818) |
| 3847 | Key Pin for No. 3822, .066" x 3/16" |
| 3866 | Bell Crank for Bolt No. 3791 Mach. (3793) |
| 3873 | Packing for Clutch Wheel No. 3808 |
| 3874 | Packing Clip (3816) |
| 3936 | Lens Clamp Comp. (3934-3935-3937-3938) |
| 4004 | Spacer Pad Holder |
| 4019 | Bearing, Lower for Eccentric (3812) |

| Stock No. | DESCRIPTION |
|---|---|
| 41 | Screw 10-30 x $\frac{1}{16}$" Fil. |
| 47 | Screw ¼"-30 x ¼" Hdls. |
| 76 | Nut 10-30 |
| 77 | Nut ¼"-30 |
| 132 | Screw ¼"-20 Thumb |
| 2304 | Weight Lens Pressure (132) |
| 2636 | Drip Pipe ¾" x 12" |
| 3576 | Screw ¼"-20 x $\frac{1}{16}$" Hollow |
| 3778 | Screw ¼"-20 x ½" Hollow |
| 3833 | Lever to Lift Carriage (47) |
| 3834 | Latch to Lift Carriage |
| 3835 | Link to Weight Lever |
| 3836 | Weight Lever (3778) |
| 3837 | Weight Lever Stud |
| 3838 | Ball Bearing for Weight Bracket No. LS-5 |
| 3839 | Weight Bracket (3778) |
| 3878 | Weight Slide Rod (77) |
| 3912 | Hinge Pin for Side Door |
| 3913 | Main Base (3576-3912-3914) |
| 3914 | Side Door |
| 3915 | Side Door Latch |
| 3916 | Side Door Knob |
| 4003 | Shield Washer for No. 3838 |






| | |
|---|---|
| 62 | Screw ¼"-20 x ⅝ Hex. |
| 92 | Washer ¼" |
| 141 | Screw 7-40 x ⅜" Fil. |
| 519 | Cotter Pin 3/32" for No. 4010 |
| 965 | Oil Can |
| 976 | Rubber Pad—Thick |
| 3697 | Stud for Motor Base Anchor |
| 4008 | Motor Base Only |
| 4009 | Anchor for Motor Base (2/3697) |
| 4010 | Slide Rod |
| 4011 | Clamp Nut for Rubber |
| 4012 | Adjusting Thumb Nut |
| 4013 | Rubber Foot Pad |
| 4017 | Belt, Vee, for Motor |

## REPAIR PARTS NOT ILLUSTRATED

| Stock No. | DESCRIPTION |
|---|---|
| 38 | Screw 7-40 x 1/8" Hdls. |
| 78 | Nut 1/4"-20 |
| 98 | Screw 3/16"-18x3/8" Hollow |
| 122 | Screw 10-30 x 3/8" Hdls. |
| 129 | Screw 5-40 x 1/2" Fil. |
| 154 | Nut 1/4"-30 |
| 265 | Screw 10-30 x 7/16" Fil. |
| 266 | Screw 10-30 x 1/2" Hdls. |
| 629 | Ball 3/16" Steel |
| 672 | Pin 3/16" x 7/16" |
| 696 | Pin 1/8" x 9/16" |
| 963 | Stone 1" x 10" turned (Code 1002) |
| 977 | Rubber Pad, Medium |
| 981 | Rubber Pad, Thin |
| 1078 | Pin 1/8" x 1/2" |
| 1821 | Escutcheon Pin No. 15 |
| 1852 | Grease Gun |
| 2009 | Fiber Thread Protector, 1/8" |
| 2110 | Motor Pulley 2 1/8" Vee Belt (98) D. 262 |
| 2178 | Pin, 3/16" x 13/32" |
| 2180 | Spring for 3776 |
| 2214 | Packing for Eccentric 3896 |
| 2324 | Drip Pipe Assembly (2311-2349) |
| 2349 | Street Elbow 3/4" |
| 2448 | Pin .075" x 3/8" |
| 2948 | Pin, 3/16" x 13/16" |
| 2951 | Spring for Osc. Link O. S. (see 4024) |
| 3771 | Bevel Cear 12T No. L. 148 in 3782 |
| 3772 | Bevel Gear 24T No. L. 148 in 3766 |
| 3787 | Cover for Tip-up Slot. Blank in 3789 |
| 3788 | Name Plate (use 1821 pins) |
| 3793 | Bell Crank for Bolt. Blank in 3866 |
| 3796 | Packing for Carriage End Cover |
| 3811 | Lens Clamp Fork (3814) |
| 3814 | Lens Clamp Fork Blank in 3811 |
| 3816 | Friction Clip for Ecc. Blank in 3811 |
| 3818 | Ball Bearing Cup, Blank in 3840 |
| 3819 | Ball Bearing Cone, Back Shaft |
| 3820 | Ball Bearing retaining Washer |
| 3823 | Gear, mitre, Blank No. L. 111 |
| 3828 | Vertical Shaft, Center |
| 2 | Screw 10-30 x 7/8" Fil. |
| 5 | Screw 10-30 x 3/16" Hdls. |
| 13 | Screw 1/4"-30 x 3/8" Hdls. |
| 18 | Screw 10-30 x 5/16" Fil. |
| 31 | Screw 1/4"-20 x 3/4" Fil. |
| 34 | Screw 1/4"-30 x 7/8" Set |
| 40 | Screw 7-40 x 5/16" Fil. |
| 145 | Screw 1/4"-30 x 3/8" Set |
| 435 | Screw 10-30 |
| 2247 | Clip for Contact Plate |
| 2431 | Screw 3-56 x 3/16" But. |
| 2838 | Pin 1/8" x 13/16" |
| 3751 | Friction Leather 3/16" |
| 3754 | Chisel Point for Index Dial |
| 3755 | Chisel Point Spg. Index Dial |
| 3756 | Chisel Point Screw Index Dial |
| 3773 | Range Post for Index Dial |
| 3841 | Index Dial (Range Post is No. 3773) |
| 3842 | Index Dial Stem |
| 3843 | Contact Plate (38-2009-2247-2/2431-2/3845-3846) |
| 3844 | Contact Plate Arm (5) |
| 3845 | Contact Plate Adj. Screw |
| 3846 | Contact Plate Adj. Screw Plate |
| 3853 | Base for Water Can |
| 3854 | Stud for Water Can Base |
| 3855 | Yoke for Carriage (2/13-34-145-154-435) |
| 3856 | Wood Cup Bearing |
| 3859 | Pivot Stud for Carriage—Right |
| 3860 | Pivot Stud for Carriage—Left |
| 3861 | Eccentric to Position Lenses (3922) |
| 3862 | Handle for Eccentric No. 3861 |
| 3863 | Handle Stem (3862) |
| 3864 | Oscillator Link |
| 3887 | Oil Cup, Hinged 5/16" |
| 3906 | Water Can (4026) |
| 3907 | Water Can Nozzle |
| 3908 | Water Can Nozzle Joint (3907) |
| 3909 | Valve Stem (3910) |
| 3910 | Valve Stem Head |
| 3922 | Screw 1/4"-30x7/8" in 3861 |
| 4022 | Ball Cup for Link, Threaded |
| 4023 | Ball Cup for Link, Grooved |
| 4024 | Ball Cup Spring |
| 4025 | Tube for Valve Stem |
| 4026 | Screw to Clamp Tube (4025) |

| Stock No. | DESCRIPTION |
|---|---|
| 3830 | Carriage Comp. (4/2-44-681-2180-2838-4/3492-3546-3760-3761-3763-3764-3765-3766-3767-3774 3775-3776-3777-3779-3781 3782-3783-3784-3785-3786 3789-3790-3791-3792-3794 3795-3797-3798-3799-2/3800-3801-2/3802-3803 3804-3805-3806-3808-3809 3812-3813-3815-3817-3820 3821-3822-3827-3829-3831 3866-3873-3874-2/3887 3830 |
| 3851 | Connector for Switch Wire |
| 3852 | ⅜" Bushing for Wire |
| 3858 | Cone Bearing, Upper |
| 3865 | Ball Cup Bearing in Link O. S. See 4022, 4023 |
| 3877 | Sponge Tube—Collar |
| 3888 | Stone on Arbor (963-3889) |
| 3889 | Stone Arbor only, Comp. (4/116-3880-3881-3882) |
| 3929 | |
| 3932 | Lens Clamp, Upper, Blank |
| 3933 | Lens Clamp, Lower,Blank |
| 3934 | Lens Clamp, Spring |
| 3935 | Lens Clamp Hinge Pin |
| 3937 | Lens Clamp, Upper Mach. (3932) |
| 3938 | Lens Clamp, Lower Mach. (3933) |
| 4014 | Motor Base Comp. (4/62-4/92-3/141-519-4/976-4008-4009-4010-2/4011-4012-3/4013) |
| 4020 | Switch for Motor |
| 4021 | Switch Box B. 345 |

**STAND No. 78A Takes**

4/28-4/112-4/1113-4/1130-2/1947-1949-4028

# SECTION XII

# BENCH WORK ASSEMBLY

# BENCH WORK ASSEMBLY

When assembling a pair of lenses into a frame a preliminary inspection of the lenses and frame will eliminate much breakage. The correct size of both lenses and frame being of primary importance.

Inspect the lenses for bevel and chips first. The bevel should be straight and of the correct pitch. A sharp bevel will contact the eyewire at only one point and sooner or later will flake. A safety bevel should be run on all lenses. Examine the lens closely for minute chips in the edge of the bevel, a small chip here will also result in a flake sooner or later.

If a lens flakes during assembly or after completion, it is the fault of the benchman, not the edge grinder, because if the benchman had inspected the lens carefully before assembling it would have been sent back to the edger to be corrected.

All lenses coming from the edger should be marked at the *top* of the lens, R for right lens and L for left lens. It is important that the identity of each lens be definitely established because in the majority of the cases the lenses will be of unequal power. Where a cylindrical element is incorporated in the lens the reversal of the lenses would result in the axes being off. Decentration would be reversed and produce twice the original amount in the opposite direction, the same holds true in the case of a prismatic correction. Example: If the right lens was decentered in 2 m.m. and the left lens decentered in 1 m.m., upon reversal of the lenses you would have a total decentration of 3 m.m. out when the desired was 3 m.m. in, giving a resultant of 6 m.m. decentration in the wrong direction. This amount of decentration would produce a decided prism in even a weak lens.

When dealing with sphero cylinders always check and mark the lens up again before proceeding with the assembly. The same rule applies to prism corrections.

The next step is a close examination of the frame. Check for eye size to be sure that the proper size frame has been selected for the job. On almost all frames the eyewire will need to be bent to conform more closely with the shape of the lens. The most glaring of these is the lack of sufficient forward curve at the top of the eyewire. This can be corrected by placing the bit of the screw driver in the channel of the eyewire from the back, or temple side, and pushing forward until the desired curve is attained. This must be done while the end pieces are together, or it will result in the eyewire being twisted.

Next, remove the endpiece screws allowing the eyewire to open. Again you will find one or two places needing bending in order to match the lens shape more readily. The more common of these are the spots just below the endpiece and the top of the frame. These few slight straightening bends will correct most all new frames.

Next, using the rat-tail file in the channel, file off the raised lip you will find at the junction of the endpiece and the eyewire. This small lip, if left on, will often cause flaking after delivery of the completed job.

Now that you have inspected the lenses for bevel, chips, proper size, and flakes, and the frame has been bent to proper shape and the junction lip filed off, the bevel wiped clean, and the eyewire channel cleaned out, you are now ready to insert the lenses in the frame.

A lens is placed in the frame, being careful to center the ridge of the bevel in the channel all the way around, and the endpieces are gradually drawn together with a pair of pliers. Use a gentle steady pressure in this operation, never forcing, and constantly checking to see that the ridge of the bevel is in the channel

of the eyewire at all times. If it is not possible to completely close the endpieces, with a gentle pressure, notice if the bevel is in the channel of the eyewire. If it is, then the fault lies with the edgegrinder for not having removed enough glass. If the endpieces close properly, attempt to twist the lens in the eyewire to determine whether or not the lens is too small. You should not be able to move the lens. If you can move the lens in the eyewire, it may be tightened by use of a lens washer. Place the washer in the channel of the eyewire and place the lens in over it.

After the lens and frame are correctly matched the endpiece screw is inserted and tightened. Tighten gently, it is easy to flake a lens in this operation.

After the lenses have been inserted recheck the whole job for chips, flakes, looseness, strain (under the Colmascope) and be sure that the endpieces fit flush with each other.

PROCEDURE

Inspect bevel for pitch and trueness.

Inspect lens for chips and flakes.

Check lenses for correct markings and remark where required.

Check frame for eyesize and shape.

Check eyewire for shape and file endpiece lip.

Clean the bevel and the eyewire channel.

Insert the lenses and check for fit.

Final assembly and final check.

FINAL FRAME ASSEMBLY AND INSPECTION - With the lenses correctly installed in the front you are now ready for the final assembly and inspection.

First check the bridge size and the temple length against the Rx.

Affix the temples and tighten the endpiece screws all the way down. Each temple should have about a 15 degree spread. This can be accomplished by filing the check lug on the butt of the temple until the desired spread is attained.

Next lay the job down on a flat surface with the temples open. The curve of each temple and the top of each eyewire should touch the surface. If they do not, adjust the pantoscopic or retroscopic tilt of the offending temple by bending the endpiece of that temple as explained under endpiece angling in Fitting and Adjusting.

Next close the temples and if they do not lie straight and even across the back of the glasses adjust until they do by bending the endpiece as above.

Now make any special bends that may be called for on the Rx, such as; special shaping of the bridge, unequal spread of pads, etc.

## BENCH WORK ASSEMBLY

### FINAL INSPECTION

1. Both eyes on line and four points touching.

2. Bridge symmetrical or bent to Rx specifications and aligned properly with the eyewires.

3. Distance between lenses (D.B.L.) verified.

4. Check the distance between the optical centers of the lenses for interpupillary distance or decentration.

5. Check temples for proper length.

6. Measure width between temples one inch back of joint and check with Rx.

7. Temples aligned, open and closed.

8. Joints of endpieces closed and parallel.

9. Screws not scored.

10. No gaps in the eyewire.

11. Completed job clean (lenses, pads, and rims)

12. No plier marks or scratches of any kind.

PANTOSCOPIC TILT - The angling of the temple by bending the endpiece downward toward the bottom of the lens.

RETROSCOPIC TILT - The angling of the temple, by bending the endpiece, upward or toward the top of the lens.

# SECTION XIII

# SURFACE GRINDING

# SURFACE GRINDING

A prime requisite for rapid and successful lens surfacing is cleanliness. Keep the benches, machines and tools free from emery and all the different abrasives in separate covered receptacles. Lens and shell (Lap) must be thoroughly washed after each operation, using a brush if necessary to be sure that every particle of the coarser emery is removed. Particular care should be taken to keep the protractor, vertometer and prescription trays clean so that the finished surfaces will not be abused.

Select a lens blank as near as possible to the shape of the finished lens and allow no more thickness than is necessary. To finish a surface to the same curve as the blank which is put in work will necessitate the removal of at least 0.6 mm. of glass. Where the curve on the finished lens is to be different from that on the blank, allowance in thickness should be made for the difference in the depths of the curves in addition to that necessary for surfacing. (See M.S.S.S. Chart 2-0-112).

To compute lens thickness where a center thickness grinder is used, it is necessary only to compute the cylinder value on the 180° line of the lens, find the strap and center thickness and spot the center. Having this point to control the thickness, and the calipering points marked out symmetrically to the 180° line, there will be no prismatic effect if the opposite calipering points are kept equal, regardless of the actual lens thickness or location of the cylinder axis.

If a center thickness grinder is not available, it is necessary to know the actual edge thickness at the calipering points. This may be found by the use of the following Power of Cylinders Chart:

| Degrees From Axis | | Value for 1.0 D | Degrees From Axis | | Value for 1.0 D |
|---|---|---|---|---|---|
| 0 | 180 | .00 | 45 | 135 | .50 |
| 5 | 175 | .01 | 50 | 130 | .59 |
| 10 | 170 | .03 | 55 | 125 | .67 |
| 15 | 165 | .07 | 60 | 120 | .75 |
| 20 | 160 | .12 | 65 | 115 | .82 |
| 25 | 155 | .18 | 70 | 110 | .88 |
| 30 | 150 | .25 | 75 | 105 | .93 |
| 35 | 145 | .33 | 80 | 100 | .97 |
| 40 | 140 | .41 | 85 | 95 | .99 |

Inasmuch as the spherical power of a compound lens is a constant it is only necessary to determine the spherical equivalent of the cylinder at the given axis.

Example:

+5.00 (cylinder) axis 60

+5.00 (cylinder) x .75 (Percentage as taken from chart) equals +3.75 actual power of cylinder at the cutting line (180°).

Example:

+1.00 (Sphere) +2.00 (Cylinder) x 135

+2.00 (Cylinder) x .50 (Percentage as taken from chart) equals +1.00 actual power of cylinder at the cutting line (180°).

+1.00 (Sphere) +1.00 (Spherical equivalent of cylinder) equals +2.00 actual power of the compound lens at the cutting line (180°).

For cylinder powers other than 1.00 D. use the last column as percentages of the given cylinder value.

In the case of single vision lenses, which can be calipered at any point on the periphery, it is possible to make the calipering points symmetrical with the cylinder axis regardless of the 180° line so that all four measuring points will be of equal thickness in prescriptions without prism.

Prism will never be ground on a lens if the lens size and power permits the results to be obtained by decentration as described in Subject 0-104.

On blocking the lens it is necessary to center the lens on the block, using enough blocking pitch to be sure of firm attachment. Heat glass and block slowly to prevent cracking, apply pitch to both, and press glass onto block.

When using rough emery inspect the lens frequently for prism and press the thick side to keep the blank symmetrical.

Before using a medium or smoothing emery be sure the lens is clear of all coarse emery. Grind with smoothing emery until all pits and scratches have disappeared.

The fining process should require no longer than 2 or 3 minutes and the lens should have a smooth black appearance. A lens properly fined will polish out in a minimum of time. Much off-focus trouble is caused by insufficient fine grinding and too much polishing.

For polishing, a good grade of closely woven serge should be used. The thinner the better so long as the pitch does not work through.

Heat the shell and apply a thin even coat of pitch. Apply the polishing cloth and press down with the mate shell. (Lap).

Inasmuch as resin is available at Medical Supply Depots and tar can be obtained from similar installations of the Engineer Corps, the processing of pitch can be accomplished under most field conditions. A satisfactory formula consists of 10 quarts of resin to 1/4 pound of tar. During cold weather the tar content may be increased to as much as 3/4 of a pound to increase its qualities of adhesion.

The rouge should be applied moist, frequently and in small quantities. When the lens is nearly polished, allow the rouge to work itself out and for the last few minutes of finishing run the polisher nearly dry. This removes all stripes and produces a very high finish on the lens surface. The finishing must be watched very closely to prevent the polisher from heating and softening, which would destroy the accuracy of curve of the surface and stripe the lens.

When the lens is polished it must be removed from the block. Allow the lens to cool slightly after polishing, then place in ice water, or better still, set lens block down on a cake of ice which may be kept in any available container. This will contract the pitch and loosen the lens from the block. The lens may then be cleaned with alcohol (wood or denatured) to remove excess pitch and other materials.

The grinding tools or shells will be gauged for curve accuracy each time they are used. A full set of gauges for this purpose will be standard equipment in all Army optical repair units required to do surface grinding.

LENS THICKNESS - It is a well known fact that while plus lenses are thickest at the center, minus lenses are thinnest at the center. In shop practice, however, problems arise which demand a much more accurate knowledge regarding the thickness of lenses.

In order to answer such questions, it is necessary to know the depth of the curves, called the "Sagitta". A formula can be obtained by applying the Pythagorean theorem to the triangle formed by the center inner surface, the center outer surface and the apex of the lens.

In order to eliminate the necessity for solving a mathematical problem each time a lens thickness is required, M.S.S.S. Chart 2-0-112 has been prepared for your guidance.

Example: Assume a minus lens with an outside curve of +6.00 D, an inside curve of -10.00 D, and a center thickness of 0.5 mm. What is the edge thickness if the lens has a diameter of 52 mm.?

Answer: In the 52 mm. column, M.S.S.S. Chart 2-0-112 shows a depth of 6.82 mm. for 10.00 D and a depth of 3.91 mm. for a 6.00 D curve. The difference between these depths is 2.91 mm. This would be the edge thickness if the lens had no center thickness. Since, however, the center thickness is 0.5 mm., the edge thickness is not 2.91 mm. but 2.91 + 0.5 mm. = 3.41 mm.

The usual optical shop method of determining lens thickness is computed in points. It is necessary to determine whether the calipers are calibrated at 5 or 10 points per millimeter as both types are in common use. For instructional purposes, we will assume all calipers to be calibrated at 5 points per millimeter.

By using the following formula a close approximation can be made:

| Millimeters (diameter) | | | | | | | |
|---|---|---|---|---|---|---|---|
| 38 | 40 | 42 | 44 | 46 | 48 | 50 | 52 |
| Points per diopter. | | | | | | | |
| 2 | 2 | 2½ | 2½ | 2½ | 3 | 3 | 3½ |

Example: Assume a minus lens with an outside curve of +6.00 D, an inside curve of -10.00 D, and a center thickness of 0.5 mm. What is the edge thickness if the lens has a diameter of 52 mm.

Answer: Obviously the power of the lens is -4.00 D. The diameter of the lens being 52 mm. the chart gives 3½ points per diopter as the multiplier. The desired center thickness is 0.5 mm. or 2½ points. Therefore the answer would be derived as follows:

$$4 \times 3\frac{1}{2} + 2\frac{1}{2} = 16\frac{1}{2} \text{ points (edge)}$$

Example: Assume a plus lens with an outside curve of +10.00 D, and an inside

curve of -6.00 D, and an edge thickness of 0.5 mm. What would be the center thickness if the lens has a diameter of 52 mm.?

Answer: The power of the lens is plus 4.00 D. The diameter of the lens being 52 mm. the chart gives 3½ points per diopter as the multiplier. The desired edge thickness is 0.5 mm. or 2½ points. Therefore, the answer would be derived as follows:

$$4 \times 3\tfrac{1}{2} + 2\tfrac{1}{2} = 16\tfrac{1}{2} \text{ points (center)}$$

This method, while not absolutely accurate, is of sufficiently close approximation to warrant its general use to eliminate involved mathematics when a depth of curves chart is not available.

SHURON OPTICAL COMPANY

SURFACE GRINDING

DEPTH OF CURVES
INDEX 1.53

MSSS Chart 2-0-112

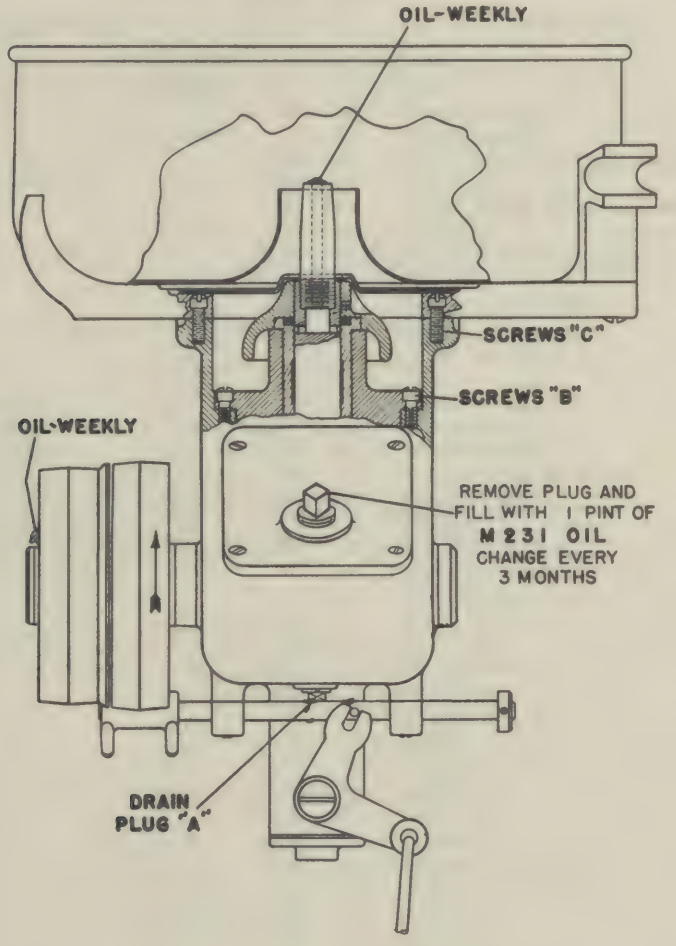
| Power | DIAMETER OF LENS IN MILLIMETERS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 34 | 36 | 38 | 40 | 42 | 44 | 46 | 48 | 50 | 52 |
| 0.25 | 0.07 | 0.08 | 0.08 | 0.10 | 0.11 | 0.12 | 0.13 | 0.14 | 0.15 | 0.16 |
| 0.50 | 0.14 | 0.16 | 0.17 | 0.19 | 0.21 | 0.23 | 0.26 | 0.28 | 0.30 | 0.32 |
| 0.75 | 0.20 | 0.23 | 0.25 | 0.28 | 0.31 | 0.34 | 0.37 | 0.41 | 0.44 | 0.48 |
| 1.00 | 0.27 | 0.31 | 0.34 | 0.38 | 0.42 | 0.46 | 0.50 | 0.55 | 0.59 | 0.64 |
| 1.25 | 0.34 | 0.38 | 0.42 | 0.47 | 0.52 | 0.57 | 0.62 | 0.68 | 0.74 | 0.80 |
| 1.50 | 0.41 | 0.46 | 0.51 | 0.57 | 0.63 | 0.69 | 0.75 | 0.82 | 0.89 | 0.96 |
| 1.75 | 0.48 | 0.54 | 0.60 | 0.66 | 0.73 | 0.80 | 0.87 | 0.95 | 1.03 | 1.12 |
| 2.00 | 0.55 | 0.61 | 0.68 | 0.76 | 0.83 | 0.92 | 1.00 | 1.09 | 1.18 | 1.28 |
| 2.25 | 0.61 | 0.69 | 0.77 | 0.85 | 0.94 | 1.03 | 1.13 | 1.23 | 1.33 | 1.44 |
| 2.50 | 0.68 | 0.77 | 0.86 | 0.95 | 1.04 | 1.15 | 1.25 | 1.36 | 1.48 | 1.60 |
| 2.75 | 0.75 | 0.84 | 0.94 | 1.04 | 1.15 | 1.26 | 1.38 | 1.50 | 1.63 | 1.76 |
| 3.00 | 0.82 | 0.92 | 1.02 | 1.14 | 1.25 | 1.38 | 1.50 | 1.64 | 1.78 | 1.92 |
| 3.25 | 0.89 | 1.00 | 1.11 | 1.23 | 1.36 | 1.49 | 1.63 | 1.78 | 1.93 | 2.09 |
| 3.50 | 0.96 | 1.07 | 1.20 | 1.33 | 1.46 | 1.61 | 1.76 | 1.91 | 2.08 | 2.25 |
| 3.75 | 1.03 | 1.15 | 1.28 | 1.42 | 1.57 | 1.72 | 1.88 | 2.05 | 2.23 | 2.41 |
| 4.00 | 1.09 | 1.23 | 1.37 | 1.52 | 1.67 | 1.84 | 2.01 | 2.19 | 2.38 | 2.58 |
| 4.25 | 1.16 | 1.31 | 1.46 | 1.61 | 1.78 | 1.96 | 2.14 | 2.33 | 2.53 | 2.74 |
| 4.50 | 1.23 | 1.38 | 1.54 | 1.71 | 1.89 | 2.07 | 2.27 | 2.47 | 2.68 | 2.90 |
| 4.75 | 1.30 | 1.46 | 1.63 | 1.81 | 1.99 | 2.19 | 2.40 | 2.61 | 2.84 | 3.07 |
| 5.00 | 1.37 | 1.54 | 1.72 | 1.90 | 2.10 | 2.31 | 2.53 | 2.75 | 2.99 | 3.24 |

| | 34 | 36 | 38 | 40 | 42 | 44 | 46 | 48 | 50 | 52 |
|---|---|---|---|---|---|---|---|---|---|---|
| 5.25 | 1.44 | 1.62 | 1.80 | 2.00 | 2.21 | 2.43 | 2.65 | 2.89 | 3.44 | 3.41 |
| 5.50 | 1.51 | 1.70 | 1.89 | 2.10 | 2.32 | 2.54 | 2.79 | 3.04 | 3.30 | 3.57 |
| 5.75 | 1.58 | 1.77 | 1.98 | 2.20 | 2.42 | 2.66 | 2.92 | 3.18 | 3.46 | 3.75 |
| 6.00 | 1.65 | 1.85 | 2.07 | 2.29 | 2.53 | 2.78 | 3.05 | 3.32 | 3.61 | 3.91 |
| 6.25 | 1.72 | 1.93 | 2.16 | 2.39 | 2.64 | 2.90 | 3.18 | 3.47 | 3.77 | 4.08 |
| 6.50 | 1.79 | 2.01 | 2.24 | 2.49 | 2.75 | 3.02 | 3.31 | 3.61 | 3.93 | 4.26 |
| 6.75 | 1.86 | 2.09 | 2.33 | 2.59 | 2.86 | 3.14 | 3.44 | 3.76 | 4.09 | 4.43 |
| 7.00 | 1.93 | 2.17 | 2.42 | 2.69 | 2.97 | 3.27 | 3.58 | 3.90 | 4.25 | 4.60 |
| 7.25 | 2.00 | 2.25 | 2.51 | 2.79 | 3.08 | 3.39 | 3.71 | 4.05 | 4.41 | 4.78 |
| 7.50 | 2.08 | 2.33 | 2.60 | 2.89 | 3.19 | 3.51 | 3.85 | 4.20 | 4.57 | 4.95 |
| 7.75 | 2.15 | 2.41 | 2.69 | 2.99 | 3.30 | 3.64 | 3.98 | 4.35 | 4.73 | 5.14 |
| 8.00 | 2.22 | 2.49 | 2.78 | 3.09 | 3.42 | 3.76 | 4.12 | 4.50 | 4.90 | 5.32 |
| 8.50 | 2.36 | 2.65 | 2.97 | 3.29 | 3.64 | 4.01 | 4.40 | 4.80 | 5.23 | 5.68 |
| 9.00 | 2.51 | 2.82 | 3.15 | 3.50 | 3.87 | 4.26 | 4.68 | 5.11 | 5.57 | 6.05 |
| 10.00 | 2.80 | 3.15 | 3.52 | 3.92 | 4.34 | 4.78 | 5.25 | 5.75 | 6.27 | 6.82 |
| 10.50 | 2.95 | 3.32 | 3.71 | 4.13 | 4.58 | 5.05 | 5.54 | 6.07 | 6.63 | 7.21 |
| 11.50 | 3.25 | 3.66 | 4.10 | 4.57 | 5.06 | 5.59 | 6.15 | 6.74 | 7.37 | 8.03 |
| 12.00 | 3.40 | 3.83 | 4.30 | 4.79 | 5.31 | 5.87 | 6.46 | 7.09 | 7.76 | 8.46 |
| 13.00 | 3.71 | 4.19 | 4.70 | 5.24 | 5.82 | 6.45 | 7.11 | 7.81 | 8.56 | 9.38 |
| 14.00 | 4.03 | 4.55 | 5.11 | 5.71 | 6.36 | 7.05 | 7.79 | 8.58 | 9.43 | 10.34 |
| 15.00 | 4.36 | 4.93 | 5.54 | 6.21 | 6.92 | 7.68 | 8.51 | 9.40 | 10.36 | 11.41 |

## INSTRUCTIONS FOR OPERATING AO M415A HAND SURFACING MACHINE

Every machine is carefully tested and operated for several days before it is packed for shipment. With ordinary care and attention, and provided the following instructions are carefully followed, and AO M415A Hand Surfacing Machine will give long and satisfactory service.

Before this can be mounted on the bench, screws "C" must be removed to allow the top housing to be separated from the lower housing. We recommend a one-half horse power motor for a single machine; two spindles require one horse power; three spindles, one and one-half horse power, etc. This eliminates any possibility of overloading the motor under all conditions.




The lap spindle is provided with a detachable tapered end which can be removed by unscrewing with an ordinary wrench. The speed of this spindle is the same as that of the driving pulley. If the machine is used for both grinding and polishing, the driving pulley should run at approximately 875 RPM with the top turning toward the operator. For polishing only, the speed can be increased to suit individual requirements.

OILING - Follow the chart to obtain long and satisfactory service. All small bearings on this machine should be oiled before operating. Pour into the gear box the supply of AO M231 Oil furnished with the machine. This oil should be changed every three months. When changing, if it is not convenient to secure AO M231 Oil, use Fiske's K-30 or its equivalent.

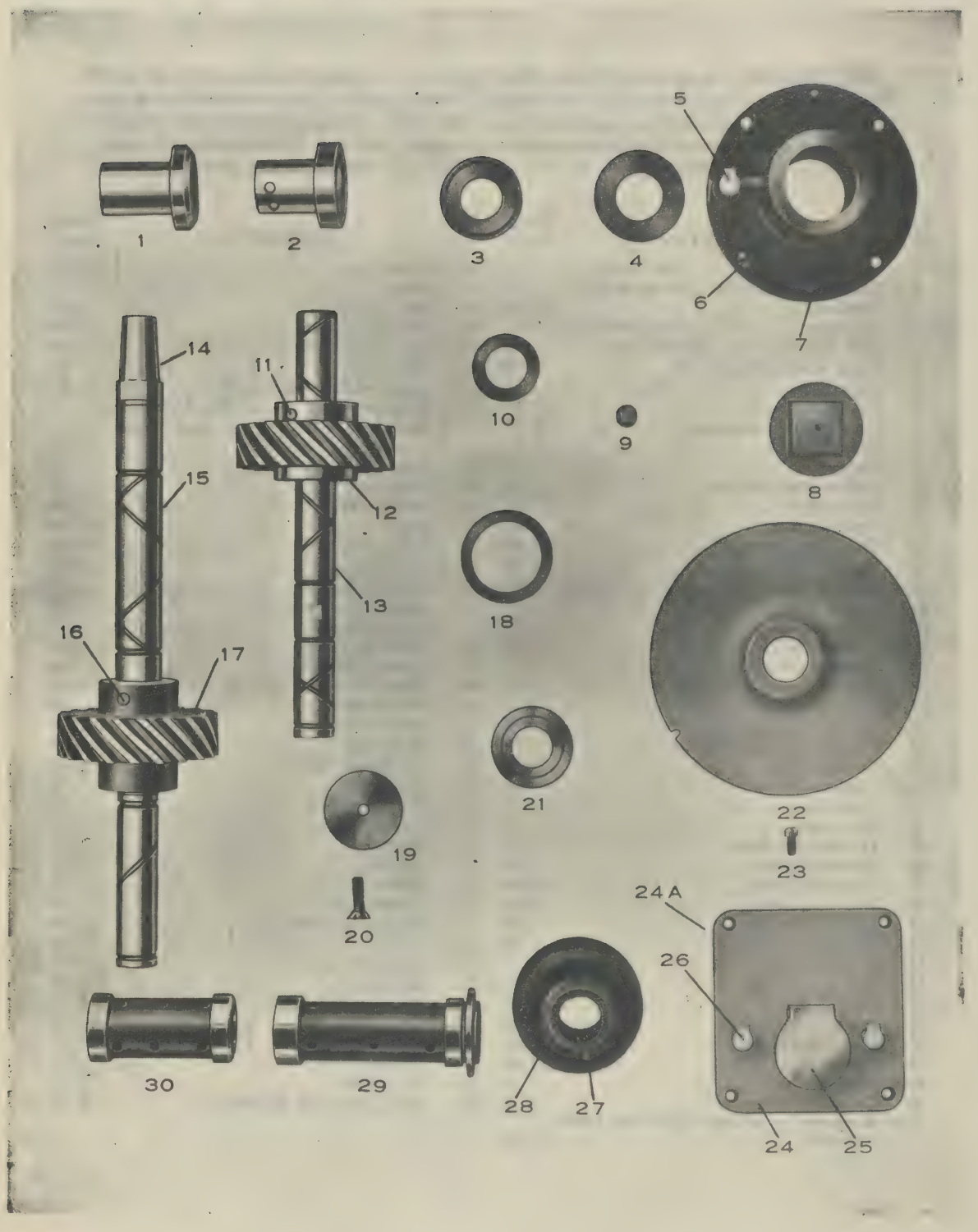
REPAIRS - When necessary to reach inside the machine, remove the four screws "B" under the dust shield. The lap spindle, bearings, and gear can then be taken out as an entire unit and every part easily reached for repairs.

# AO M415
# SURFACING MACHINE
# DESCRIPTIVE LIST OF REPAIR PARTS

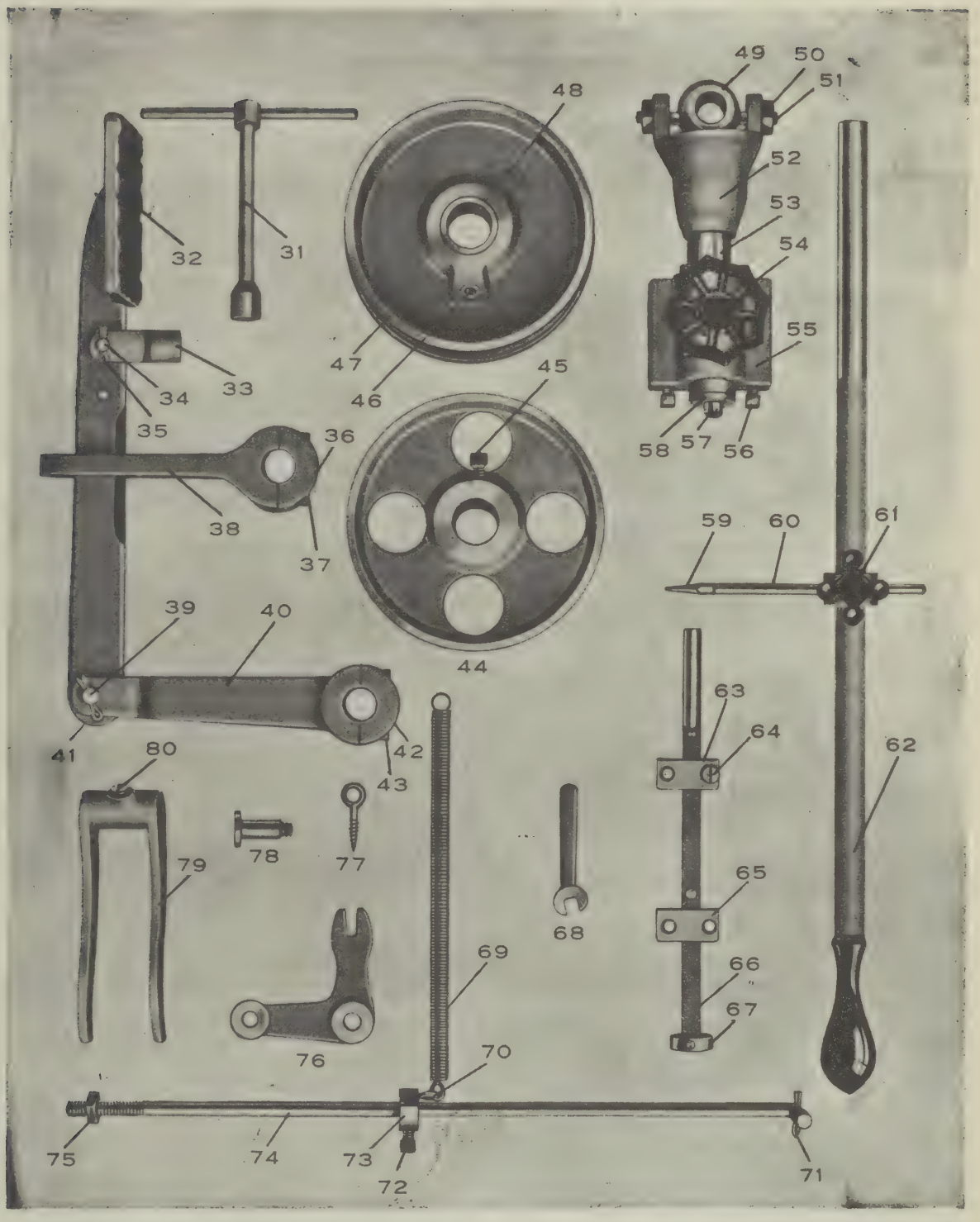
**When ordering repair parts, always give serial and catalog numbers of the machine; also catalog number and description of the part required. Whenever possible, the old part should be submitted with the order. Improvements and changes have been made on AO machines at different times, and full information will assist us greatly in interpreting your requirements and also assure you of prompt service.**

| Part No. | DESCRIPTION | Price Each |
|---|---|---|
| 1 | Bushing . . . . Not Available | |
| 1-A | Bushing — oilless type (not illustrated) . . . . . | $3.50 |
| * 2 | Bushing . . . . Not Available | |
| 3 | Ball bearing with part 21 . . . | 4.00 |
| 4 | Fiber washer for No. 15 . . . . | .10 |
| 5 | Gits oiler. . . . . | .20 |
| 6 | Fil. H'd screw . . . . . | .05 |
| 7 | Upper flange bearing . . . . . | 5.50 |
| 8 | Plug . . . . . | 1.50 |
| 9 | Plug . . . . . | .20 |
| 10 | Felt washer for No. 2 . . . . . | .10 |
| 11 | Taper pin . . . . . | .05 |
| 12 | Gear (driver) . . . . . | 4.50 |
| 13 | Shaft (horizontal) . . . . . | 3.00 |
| 14 | Lap holder . . . . . | 2.50 |
| 15 | Spindle (Vertical) . . . . . | 3.50 |
| 16 | Taper pin . . . . . | .05 |
| 17 | Gear (driven) . . . . . | 4.50 |
| 18 | Gasket for No. 8 . . . . . | .10 |
| 19 | Washer for No. 13 . . . . . | .75 |
| 20 | Flat H'd screw for No. 19 . . . | .05 |
| 21 | See part 3 . . . . . | |
| 22 | Cover . . . . . | 2.50 |
| 23 | Fil. H'd Sc'r for 24. . . . . | .05 |
| 24 | Cover . . . . . | 2.75 |
| 24-A | Gasket . . . . . | .25 |
| 25 | Gits oiler. . . . . | .35 |
| 26 | Gits oiler. . . . . | .10 |
| 27 | H'dless set screw . . . . . | .05 |
| 28 | Spindle guard . . . . . | 2.00 |
| 29 | Upper bushing . . . . . | 10.50 |
| 30 | Bushing (lower) . . . . . | 3.00 |
| 31 | Socket wrench . . . . . | 1.00 |
| 32 | Treadle . . . . . | 1.00 |
| 33 | Treadle conn . . . . . | .45 |
| 34 | Pin . . . . . | .15 |
| 35 | Cotter pin . . . . . | .05 |
| 36 | Cap . . . . . | .25 |
| 37 | Hex head screw . . . . . | .05 |
| 38 | Latch . . . . . | 1.00 |
| 39 | Pin . . . . . | .15 |
| 40 | Treadle hanger . . . . . | 1.25 |
| * 2-A | Bushing — oilless type (not illustrated) . . . . . | 3.50 |
| 41 | Cotter pin . . . . . | $ .05 |
| 42 | Cap . . . . . | .25 |
| 43 | Hex. head screw . . . . . | .05 |
| 44 | Driving pulley . . . . . | 2.50 |
| 45 | Sq. H'd set screw for No. 44 . . . | .05 |
| 46 | Ball oiler . . . . . | .10 |
| 47 | Loose pulley with bushing . . . | 4.50 |
| 48 | Bushing . . . . Not Available | |
| 48-A | Bushing—oilless type (not illustrated) . . . . . | 2.75 |
| 49 | Hand lever bearing. . . . . | .75 |
| 50 | Nut . . . . . | .10 |
| 51 | Pivot screw . . . . . | .20 |
| 52 | Yoke . . . . . | 2.50 |
| 53 | Yoke sleeve . . . . . | 1.00 |
| 54 | Handwheel . . . . . | .60 |
| 55 | Yoke bracket . . . . . | 1.75 |
| 56 | Square head set screw . . . . . | .05 |
| 57 | Fil. H'd screw . . . . . | .05 |
| 58 | Washer . . . . . | .20 |
| 59 | Driving pin . . . . . | .20 |
| 60 | Stem with pin part 59 . . . . | 1.00 |
| 61 | Handwheel . . . . . | .45 |
| 62 | Hand lever . . . . . | 2.75 |
| 63 | Slide cap . . . . . | .75 |
| 64 | Fil. head screw . . . . . | .05 |
| 65 | Slide cap . . . . . | .75 |
| 66 | Shipping rod . . . . . | 1.00 |
| 67 | Collar . . . . . | .35 |
| 68 | Wrench . . . . . | .25 |
| 69 | Spring . . . . . | .40 |
| 70 | Screw eye . . . . . | .05 |
| 71 | Cotter pin . . . . . | .05 |
| 72 | Square H'd set screw . . . . . | .05 |
| 73 | Collar . . . . . | .50 |
| 74 | Fulcrum rod . . . . . | .60 |
| 75 | Hex. nut . . . . . | .05 |
| 76 | Bell crank lever . . . . . | 1.25 |
| 77 | Screw eye . . . . . | .05 |
| 78 | Shoulder screw . . . . . | 1.20 |
| 79 | Shipper fork . . . . . | .60 |
| 80 | Set screw. . . . . | .10 |
| 81 | Steel pan (not illustrated) . . . | 6.50 |

AO M415
SURFACING MACHINE
PARTS IN DETAIL



AO M415
SURFACING MACHINE
PARTS IN DETAIL



# SECTION XIV

# INSPECTION


Fig. 4. Illustration showing major parts of Lensometer

## The Instrument

1. Adjustable eye piece.
2. Wide range prism measurer, indicates prismatic power and direction of prism.
3. Lens marker—for centering and axis marking (practically automatic).
4. Aligning device—*rack* and pinion operated—permits extra-fine adjustment.
5. Adjustable for height.
6. Modern design for strength and beauty.
7. Auxiliary prism holder—for measuring bifocal segments and extra-strong prismatic powers.
8. New lens holder—natural hold.
9. Clear and substantial target.
10. Protractor wheel—clearly defined axis marker.
11. Standard lamp in bakelite housing.
12. Power wheel—graduated readings in fractional diopters between +20 and −20.
13. Sturdy construction—durable finish.
14. Magnifying attachments—give more accurate readings.
15. Lens aligning plate. The geometrical axis of the lens should be aligned with the 0—180 line of this plate.
16. Lens positioning tube.

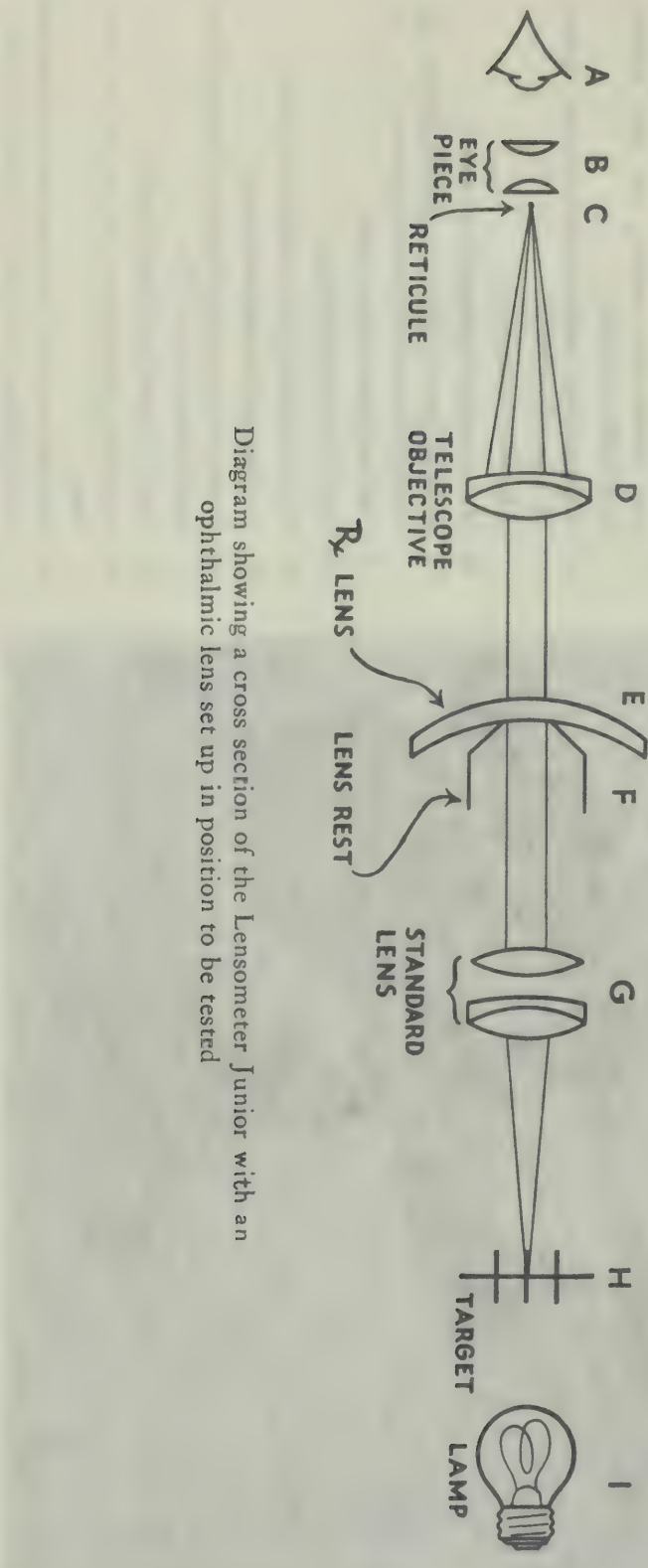



Diagram showing a cross section of the Lensometer Junior with an ophthalmic lens set up in position to be tested

## LENSOMETER

### INSPECTION

The final inspection of spectacles must determine whether or not they have been processed in accordance with the prescription. Every detail must be accurately checked and from these findings a reasonable tolerance will be permitted by Unit Commanding Officers.

The inspector should familiarize himself with a routine step-by-step check in order to eliminate the possibility of completely overlooking part of the inspection routine. When practicable, the inspection will be made from the original prescription or a carbon copy thereof rather than the work order. This procedure will tend to eliminate errors that may occur in transferring the prescription from the original to the work order.

The lenses being the most important feature of the spectacles should be inspected first, for foci, axis, decentration and prism. The frame should then be checked for correct eye size, bridge measurement, pupillary distance and temple length. The final step of the inspection should be for proper assembly including proper lens insertion, alignment of front and temples and freely working end pieces.

The inspection of lenses may be accomplished by neutralization with test lenses or preferably the lensometer with which each unit is equipped. A lens guage or measure should not be used to inspect processed work as it does not determine the power of a lens; it merely measures surface curvature. It may well be used during the operations of surface grinding or duplication of lenses.

A lens is said to be of a certain power when it will neutralize a lens of the same power but of opposite sign. Since, in this method the refractive power of the lens is measured instead of the curvature of the surfaces, it is a decided improvement over the lens measure. For symmetrical lenses it produces accurate results. For unsymmetrical lenses it is inaccurate in that it measures the focal length from the front surface of the lens.

Owing to the concave curvature of meniscus or toric lenses, it is customary to apply the neutralizing lens to the convex surface. This measures the power at the point of contact.

The best method of verifying lens power is by the use of a lensometer or similar instrument. The optical principles underlying the construction of this instrument are such that it will reveal the following information with accuracy:

1. The effective power of spheres.
2. The effective power of cylinders.
3. The effective power of compound lenses.
4. The power of prisms.
5. The direction of prismatic power.
6. The axis of cylindrical lenses.
7. The optical center of lenses.
8. The power of bifocal segments.

The Lensometer consists of four component parts:

1. Eye piece including prism measuring device.
2. Adjustable stage and hold down clamp.
3. Large wheel on the right side of the instrument numbered in red and white. (White is /, red is -.) This is known as the power or diopter wheel.
4. Round dial on back of instrument numbered from $0^{o}$ to $180^{o}$ known as the axis dial or protractor dial.

## Operation of the Lensometer

### Preliminary Adjustment

The instrument should always be adjusted to the eye of the examiner before lenses are analyzed. This adjustment is accomplished as follows:

Turn the graduated power wheel until the zero position is directly opposite the arrow on the indicator. While looking into the eyepiece, rotate it until the circulars of the reticule are sharp and clear as in Figure 8A. If the instrument has been properly adjusted the squares and bands of light on the target will be sharply defined as in Figure 8B.

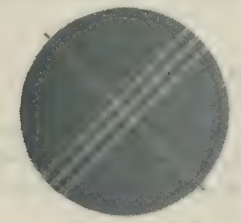


Fig. 8A—Reticule

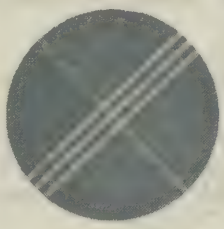


Fig. 8B—Target

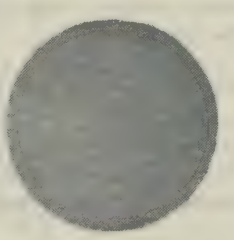


Fig. 8C—Reticule and Target combined

Superimposed on the reticule a clear image of the combined reticule will be seen as in Figure 8C.

With the instrument set correctly for the operator's eye, we are ready to proceed with any of the tests outlined on the following pages.

Fig. 9. Section showing proper position of lens being examined

### Analyzing Spherical Lenses

Insert the lens to be tested with the back or ocular surface against the lens positioning tube (See Figure 9).

While looking through the eyepiece, revolve the graduated power wheel until the squares are fairly distinct as in Figure 10A. Then move the lens until it is centered. This is indicated by the squares falling within the circle engraved on the reticule of the eyepiece as in Figure 8C.

Next, the power wheel is moved away from the operator, causing the squares to be blurred slightly as in Figure 10B then the power wheel is slowly turned *toward* the operator until the squares are sharp as in Figure 8C. Do not turn the power wheel back and forth by small amounts, because the most rapid and accurate settings are made as described. If you wish to verify the findings, repeat the entire operation.

Fig. 10A—Normal image decentered

Fig. 10B—Sphere out of focus; No cylinder

Fig. 11A—Sphere and cylinder out of focus; Axis off

The power of the sphere can be read directly from the graduated wheel -white numerals indicating plus power, and red numerals indicating minus power.

### Analyzing Plano Cylinders

Set the power wheel at zero and insert the lens to be tested with the ocular surface against the lens positioning tube, so that the geometrical axis of the lens is on the 0-180° line. The appearance of the target will be similar to that shown in Figures 11A or 11B. While looking through the eyepiece, turn the protractor on the instrument until the single line comes into focus and becomes a bright band of light. See illustration 11C. The axis of the cylinder is indicated on the protractor.

Now rotate the power wheel until the three lines come into focus, as in Figure 11D, carefully turning the power wheel until the sides of the rectangles are very sharp.

The power of the cylinder can now be read directly from the power wheel - positive if white, negative if red.

Fig. 11B—Sphere in focus; Axis off

Fig. 11C—Sphere in focus; Axis correct

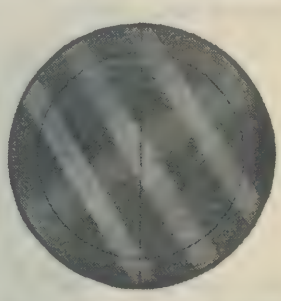


Fig. 11D—Cylinder focused

### Analyzing Sphero Cylinders

Place the lens with its ocular surface against the positioning tube of the instrument or in other words with the front surface of the lens towards the operator.

1. Bring to sharp focus either the single line as in Figure 11C or the triple line as in Figure 11D by slowly and simultaneously rotating in either direction the power and protractor wheels. Note the power reading on the power wheel. Now by rotating only the power wheel bring the opposite set of lines into sharp focus and note the power reading on the power wheel. Take the reading of least plus (or greatest minus) for the power of the sphere (the Army deals only in plus cylinders). Set the power wheel at the reading of least plus (or greatest minus) and rotate the protractor wheel until the single line is in sharp focus as in Figure 11C. The reading of the protractor gives the axis of the cylinder and the power wheel gives the power of the sphere.

2. Now focus the three lines of the target by rotating only the power wheel. This gives the second reading, the power of the sphere and the cylinder combined. By subtracting the first reading (sphere power) from the second reading (sphere and cylinder power combined) the power of the cylinder is determined.

Sphere - Least plus or greatest minus reading.
Axis - Protractor reading when single line is in focus for sphere power.
Cylinder - Second reading minus the first reading.

Examples:

| | | | |
|---|---|---|---|
| 1. | First reading: | Power wheel | ⁄1.00D |
| | | Protractor wheel | 85 degrees |
| | Second reading: | Power wheel | ⁄2.50D |
| | Sphere - ⁄1.00 | | |
| | Cylinder - ⁄1.50 ax 85 | | Rx ⁄1.00 ⁄1.50 ax 85 |
| 2. | First reading: | Power wheel | -3.00 |
| | | Protractor wheel | 90 degrees |
| | Second reading: | Power wheel | -2.50 |
| | Sphere - -3.00 | | |
| | Cylinder - ⁄0.50 ax 90 | | Rx -3.00 ⁄0.50 ax 90 |
| 3. | First reading: | Power wheel | -2.25 |
| | | Protractor wheel | 50 degrees |
| | Second reading: | Power wheel | ⁄1.00 |
| | Sphere - -2.25 | | |
| | Cylinder - ⁄3.25 | | Rx -2.25 ⁄3.25 ax 50 |

## Prisms and Decentration

With the Lensometer, it is a simple matter to decenter lesnes to obtain a predetermined amount of prismatic power, without the use of tables or any calculations whatsoever.

Fig. 12. Prism measuring device

Assume a spherical lens is to be decentered 3.00 prism diopters at 45°. First, place the lens with its ocular surface against the positioning tube, and after focusing with the power wheel align it for geometrical center. The target will then appear as in Figure 8C. Then set the prism axis scale on the telescope tube (see

Figure 12) at 45° and move the lens on the positioning tube until the center square of the target is on the third circle of the reticule and exactly in line with the dark axis line of the reticule, which has now been set at 45°. The target will then appear as in Figure 13. It will be noted that each circle on the reticule represents 1.00 prism diopter. Without changing the position of the lens, mark it with the centering device to denote the amount and direction of decentration necessary to produce that prismatic power. If the prism to be checked exceeds 5.00 prism diopters, insert an auxiliary prism in front of the telescope tube. Generally, a 5° prism from the trial case will answer the purpose.

## Verifying Finished Lenses

SPHERES - Set the graduated wheel to the prescription value and insert the lens against the positioning tube. If the images are sharp, as in Figure 8C, the lens is correct. If the wheel has to be turned, say, 0.12 Diopter to bring the image to a sharp focus, then the lens is incorrect by that amount.

Fig. 12A. Power Wheel

CYLINDERS - To verify a cylinder set the power wheel to 0.00, and the axis wheel to indicate the axis on the Rx. Place the lens on the positioning tube, with the geometrical axis horizontal and perfectly aligned on the 0-180° line. The image as seen should be three rectangles, extending along the same line as in Figure 11C, with faint bands extending out of each rectangle but sharply defined on their sides. This tests the cylinder for absence of power along the axis.

Next, move the graduated wheel to the cylindrical power appearing on the Rx. The rectangles and ribbons should be parallel to each other and should be sharply defined along their former indistinct direction as in Figure 11D.

SPHERO-CYLINDERS - Set the power wheel according to the spherical power appearing on the Rx; also set the small power indicator on this wheel at the same position. The rest of the operation is the same as for cylinders, always taking the spherical power instead of zero power as a starting point, and the sum of the

Fig. 13.
Target showing power of three prism diopter

spherical and cylinder powers for the second reading. The difference between the first and second readings represents the cylindrical power of the lens.

### Prismatic Power

To determine if a lens has been properly decentered, set the power and the axis wheels at their proper positions and place the lens on the positioning tube with the geometrical center and, in the case of a cylinder, with the axis perfectly aligned. Next turn the prism axis scale to the correct position. The image in the case of a decentered sphere should be as in Figure 13.

### Alignment of Spectacles

This is a simple attachment supplied on every Lensometer of the improved model by which the alignment of a pair of spectacle lenses, mounted and ready to deliver, can be checked for alignment of axes and prismatic power. Often lenses that have been properly surfaced are cut or edged off axis or with the wrong amount of decentration.

Fig. 16. Close up of aligning device

Also there is a possibility of perfectly surfaced and edged lenses being improperly mounted in a frame, either because the frame is out of "true", or because the drilled holes are not correctly positioned, or for various other reasons. As it is essential that the finished work comply in full with the specifications of the Rx, every job should be checked on the Lensometer before delivery to the patient.

When not in use, the aligning device should be in its lower position, as in Figure 9. When it is desired to check a mounted prescription, the device can be raised, as in Figure 16 and the mounting placed thereon.

To check such work, set the power wheel, the axis scale, and the prism scale in their proper positions and check one lens. Then move the aligning device to the right or left and check the other lens, being careful not to change the up and down position of the device.

Any discrepancy in the alignment of the finished Rx can readily be located and corrected before the work is sent out.

# SECTION XV

# EMERGENCY REPAIRS OF SPECTACLES

# EMERGENCY REPAIRS OF SPECTACLES

Optical repair units operating in the field should confine emergency repairs to those eyeglasses that the individual cannot dispense with during the period of time it takes to process replacement spectacles.

There is a wide divergence of purpose between an emergency repair and a regular optical repair. An emergency repair, as implied by the name, is of a temporary nature whereas a regular repair must render the eyeglasses serviceable for ordinary usage.

Emergency repairs will not apply to spectacles (Government Issue) or gas mask inserts as a sufficient stock of these items should at all times be available for replacement purposes. It is expected that repairs of an emergency nature will be confined to rimless eyeglasses and zylonite frames.

Individuals that have provided themselves with eyeglasses other than government issue will find it difficult, if not impossible, to have mountings or frames replaced with other than those of government issue.

Inasmuch as field optical repair units are not provided with diamond drills for perferating glass, it is obvious that the only method of repairing broken lenses contained in rimless eyeglasses will be by the use of sealing wax, Wills edge cement or some similiar substance that can be used to adhere the broken pieces together. Such a repair is not permanent but will usually suffice for a sufficient period of time to permit the processing of replacement government issue spectacles.

Temporary repairs can be made on broken zylonite frames in the following manner: Dissolve small pieces of zylonite in acetone until the substance compares in consistency with a thick syrup. Then dip the broken ends in the substance and place them carefully and firmly together. It will be necessary to devise a means, similiar to a clamp, to hold the ends together as it will require a considerable period of time (ten to twenty-four hours) for the solution to become a solid. When the rupture has been annealed it may be smoothed and polished by the use of unadulterated acetone applied with the fingers or a smooth cloth.

Frame repair screws may be used to replace missing glass screws as a tap of the correct size is standard unit equipment.

The soldering of metal frame parts should be held to a minimum. A frame that has broken in one place is usually weakened in other locations and a front or temple replacement is advisable.

Broken rimless mountings will have to be soldered as such items are not supplied to any type of field optical repair unit.

Gas mask spectacle temples may be used as replacements on any metal frame. Although gas mask spectacles are not to be worn under a gas mask, the frames should be used as replacement parts whenever practicable. The fact that a temple may not be of the same design will not prohibit its being used as a replacement in the field.

Many eyeglasses will be presented for repair that will test the ingenuity of the technical optician. In as much as repairs of this type consume excessive time, it is advisable to confine the production of field optical repair units to the repair and replacement of government issue spectacles and gas mask inserts.

It will be to the advantage of all mechanical optical technicians to familiarize themselves with the contents of Par. 24, War Department Pamphlet 8-5, which is quoted in its entirety as follows:

"24. Replacement and repairs; optical repair and replacement units.--a. Before spectacles, commercial type, or spectacles, gas mask type, are replaced or repaired, the responsible officer will assure himself that loss or breakage was in the performance of military or official duty and that no carelessness was involved. Complete replacement will be limited to those individuals entitled to spectacles in accordance with the basis of issue as set forth in paragraph 21. Instances of losses or breakages in excess of three per year will be especially investigated and reported with recommendation to The Surgeon General if in continental United States; to the department or force surgeon concerned in the case of military establishments beyond the continental limits of the United States. On review of the evidence The Surgeon General, the department surgeon, or the force surgeon will determine whether replacement or repair will be made at public expense. Repairs of breakages in the performance of duty will be further governed by the following instructions:

(1) If one lens only is broken, replacement in kind will be made, provided the individual's frame is of durable construction with rims and temples, decision as to durability to rest with the responsible medical officer. If the frame is not durable, new spectacles according to specifications and with untinted lenses will be issued.

(2) If both lenses are broken, replacement will be made by untinted lenses per eyeglass specification, these to be placed in the individual's eyeglass frame, provided the frame is of durable construction with rims and temples, decision as to durability to rest with the station surgeon. If the frame is not durable, new spectacles, according to specifications and with untinted lenses, will be issued.

(3) A frame, if broken, will be repaired provided it is of durable construction with rims and temples, decision as to durability to rest with the responsible medical officer. If the frame is not durable, new spectacles according to specifications and with untinted lenses will be furnished.

b. Optical repair and replacement units have been and are being made available in the various theaters of operation, and whenever possible these facilities should be used for the above purposes."

# SECTION XVI

# SHIPPING AND PACKING

# SHIPPING AND PACKING

The importance of packing spectacles in a manner that will permit them to arrive at their destination in a serviceable condition cannot be overemphasized.

Often, the person for whom the spectacles were processed, will have changed station and it will be necessary to forward the package over long distances. The unavoidable rough handling spectacles will receive during transit will probably render them unserviceable if they have been loosely packed.

The procedure should be as follows if practicable: Wrap the glasses with tissue paper and place in the spectacle case. Wrap the spectacle case in corrogated paper until it fits tightly in the spectacle mailing box. Wrap the box with heavy paper and tie firmly with cord.

For further guidance the following paragraphs have been extracted for War Department Pamphlet 8-5, 30 April 1943:

(A) "Spectacle mailing boxes.--Spectacle mailing boxes are stocked at the St. Louis Medical Supply Depot, St. Louis, Mo., being identified as Item No. 9N071-00, and are to be used as containers for eyeglasses being mailed personnel who have departed from their station prior to receipt of eyeglasses. Requisitions for this item will be forwarded to the office of the Surgeon General, caution being used to requisition such moderate quantities as the demand necessitates. Spectacle mailing boxes will not be purchased from the branch offices of the optical companies under contract."

(B) "Shipment and packing.--In the event spectacles, commercial type, are received from optical branches by posts, camps, or stations within the continental limits of the United States to be issued to military or other authorized personnel who have been assigned to oversea duty, the packing of such eyeglasses for shipment to APO addresses will be as follows:

a. Each individual pair of eyeglasses with case will be wrapped in a package or box for shipment, showing on the face thereof the name, serial number, grade, and APO address of the person for whom it is intended.

b. The individual packages will then be placed in one large package or box and mailed to the respective APO Address. The procedure as outlined will eliminate unnecessary work on the part of the Army post office and all shipments will be handled more expeditiously."

(C) "Disposition of eyeglasses when address of individual is unknown.--When eyeglasses are received after the individual for whom they are intended has been transferred and every effort has been made without success to determine the correct address to which the eyeglasses should be forwarded, inquiries for the correct address may be made of The Adjutant General."

The original optical prescription from which the spectacles were processed will be returned to the individual for whom it was intended. If it is desired to retain a file of prescriptions, a copy will be made for filing purposes.

The responsibility for packing and shipping should be delegated to one member of the optical repair unit and he should be impressed with the fact that packages improperly addressed and spectacles carelessly packed will constitute a loss of material, time and man power efficiency that cannot be countenanced in a zone of operations.

Frequent inspection by the officer in charge of the optical repair unit will tend to eliminate the possibility of spectacles never being received by the individual for whom they were intended or in such condition as to render them unserviceable.

# SECTION XVII

# MAINTENANCE AND REPAIR OF EQUIPMENT

# MAINTENANCE AND REPAIR OF EQUIPMENT

Field optical repair units are supplied with the finest mechanical equipment obtainable. Due to war time manufacturing difficulties the equipment on comparative units may vary as to the manufacturer. Basically the operation will be similiar, but the maintenance and repair involves a problem that makes it essential for operators of these units to be familiar with all optical machinery regardless as to the manufacturer.

The importance of preventive maintenance cannot be over emphasized. Field optical repair units operate in zones of operation outside the Continental limits of the United States and will find it difficult to replace worn or damaged equipment and must therefore inaugurate a program of maintenance that will assure the continued and efficient operation of their mechanical equipment.

Each item must be cleaned daily to remove the abrasives that accumulate from the grinding processes. If extreme care is not exercised, these abrasives will work into the spindles and bearings causing undue wear and premature replacement of parts.

Each item of equipment must be lubricated at the intervals specified on the lubrication charts furnished by the manufacturer. The proper S.A.E. grade of oil or grease will be used when obtainable. If the specified grade of oil cannot be obtained, use the next higher S.A.E., number in warm weather and the next lower S.A.E., number in cold weather. For example: If the arbor bearing on an edging machine should specify S.A.E. #30, and it could not be obtained, S.A.E. #40 would be used in warm weather and S.A.E. #20, would be used in cold weather. The foregoing will apply to all types of lubricants.

In addition to optical machinery each mobile unit will have a 2 1/2 ton truck, a 1 ton trailer and a gasoline electric generator that must be maintained in operating condition.

First echelon maintenance on the truck and trailer will be performed by the driver. This will consist of lubrication, proper inflation of tires, care of battery, tightening of nuts and bolts and such minor repairs as may be necessary. Each Medical Depot Company will have personnel trained to perform second echelon maintenance. Third and fourth echelon maintenance will be performed by the Ordnance Corps.

The driver will also operate the gasoline electric generator and is responsible for its maintenance and repair. Each generator has a Service manual and parts list supplied with it and in as much as several different makes of this item are being supplied it is essential that all instructions received with the unit be retained for reference.

For the guidance of mechanical optical technicians, Volume 4 of the Medical Supply Services School text book, contains service charts and parts lists of each piece of equipment that will be supplied mobile or portable optical repair units. These charts may be readily located in the following manner. Select the subject to which the equipment pertains and immediately after the operational instructions will be found the desired charts and parts lists.

For example:

Subject 0-109 (Marking and Cutting)
American Optical Co. diamond cutter and Shuron Optical Co., wheel cutter.
Subject 0-11 (Edge grinding)
American Optical Co., M. 840 A edging unit.
Shuron Optical Co., 77 A, edging unit. - etc.

If it becomes necessary to requisition replacement parts, it is imperative that the requisition contain all the information pertaining to the desired parts. Specify the manufacturing company, the parts number, its nomenclature and quantity desired. Requisitions submitted with insufficient information will cause undue delay and will thereby render the equipment unserviceable over a period of time that is not consistent with the Army program of maintenance.

Ingenuity must be exercised to improvise at all times to maintain each piece of equipment in satisfactory operating condition.

# GLOSSARY OF OPTICAL TERMS

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| ABERRATION | The failure of a lens to bring all the rays of light to an exact focal point. |
| ADDITION | The difference in power between the reading and distance portions of a bifocal lens. |
| ASPHERIC | With surfaces other than spherical. |
| ASTIGMATISM | That defect of a lens whereby a point object is imaged as a line or a pair of lines instead of as a point. |
| AXIS | The imaginary line passing through the optical center of a lens system. Also used to designate the meridian of no power in a cylinder lens. |
| BASE CURVE | The uniform curve on which a series of lenses is made. In the case of toric lenses, the curve of rotation. |
| BEAM | A group of parallel rays of light. |
| BICONCAVE | With two concave surfaces. |
| BICONVEX | With two convex surfaces. |
| BIFOCAL | With two focal lengths. A bifocal lens is in effect two lenses joined together. |
| BINOCULAR | Pertaining to vision with two eyes. |
| BODY | A piece of iron, glass or other material which is used to support a lens during the grinding and polishing operation. |
| BLOCK | An iron body. May hold one or more lenses. |
| BLOCKING | Attaching lenses to a block or body in position for grinding. |
| BRIDGE | Central connecting portion of a spectacle frame or mounting. |
| CALIPERS | An instrument of the shear type used for accurate thickness measurements. They were formerly often calibrated in "Points", but are now used only in either fifths or tenths of millimeters. |
| CATARACT | That diseased condition of the eye in which the crystalline lens or lens capsule becomes opaque. |
| CENTER | The optical center of a lens - the mechanical center. The nose-piece or connecting member of spectacles or eyeglasses. |
| CENTER OF ROTATION | That point near the center of the eyeball about which it rotates. The center of rotation is about thirteen mm. behind the cornea. |
| CEMENT | A material used to cause a segment or wafer to adhere to the distance lens. Hence the lens and segment taken together. A cement bifocal. |
| CHIPPING | Removing surplus glass with plier. |

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| CHROMATIC | Pertaining to color. |
| CHROMATIC ABERRATION | The inability of a lens to focus light of different colors at a single point. |
| CHUCK | A device used to center and hold objects - a work holder. |
| COMA | Spherical aberration of oblique pencils of light, so named from the comet-shaped image of a point formed by a lens exhibiting coma. |
| COMPOUND | A lens having both spherical and cylindrical elements. |
| CONJUGATE | Joined together; coupled to one another. |
| CONJUGATE FOCAL POINTS | A pair of points on the axis of a lens so related to each other that an object placed at either one is imaged at the other. |
| CONVERGENT | Proceeding toward a point. |
| CROWN GLASS OPHTHALMIC | The glass from which ophthalmic lenses are made. Distinguished from flint glass which has a higher index of refraction. |
| CRUMBING | Reducing the size of lens by flaking or chipping off small particles of glass with the use of plier tool. |
| CURL | The bend in the temple member of a spectacle which fits around the ear. The bend in the metal of a spectacle bridge adjacent to the shank attaching it to the eye-wire or strap. |
| CUTTING LINE | The $180^{o}$ line of a lens or the meridian from which the axis is measured. |
| CYLINDER LENS | A lens, one of whose surfaces is a portion of a cylindrical surface. |
| D.B.L. | Distance between lenses. |
| DCC | Double concave - same curves on both sides of lens. |
| DCX | Double convex - same curves on both sides of lens. |
| DECENTRATION | The distance between the optical center of a lens and its actual or geometrical center. Decentration is a means of obtaining prismatic action. |
| DEGREE | One three hundred and sixtieth part of the circumference of a circle. The unit used for designating the position of the axis of a cylinder or sphero-cylinder. |
| DEVIATION | The change of direction of a ray of light as in passing through a prism. |
| DEPRESSED BIFOCAL | Circular reading portion depressed in a countersink ground in the surface of the major lens so that the edge will be flush. |
| DIFFUSION | The scattering of light. |

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| DIOPTER | The unit of measurement of the refractive power of a lens. A lens whose focal length is one meter has a power of one diopter. A lens whose power is four diopter has a focal length of one-fourth of a meter. |
| DISPERSION | The separation of light into its component colors, as in passing through a prism. |
| DISTORTION | That defect of a lens whereby the images of straight lines appear curved. |
| DIVERGENT | Proceeding from a point. |
| DIVIDING LINE | The junction of the distance and reading surfaces in a bifocal lens. |
| DOWEL | Pin to hold two members in position and to hold temples, such as in endpiece of spectacle frame or mounting. |
| DROP EYE | Referring to the shape of lens wherein the lower portion is extended to increase field of vision. |
| EDGE | The flat or angled surface, usually fineground, which limits the refracting surface of a lens. It is the edge which determines the shape of a lens; i.e., round, oval, octagon, etc. |
| EMERGENT | "Coming out of it"; the emergent surface of lens is the surface from which the light leaves the lens. |
| EMERY | The abrasive used for grinding a lens surface. It is the mineral corundum and is found principally in Africa and Asia Minor. |
| END-PIECE | Lugs at the sides of frames or attached to lenses for the purpose of holding temple members. |
| EQUIVALENT FOCAL LENGTH | The focal length of a lens which is equal in refractive power to a series of two or more lenses. |
| EYE | The side of a pair of spectacles or eyeglasses. Refers to right or left, or to size or shape. |
| EYE-WIRE | The rim forming a holding member for lenses. |
| FAR POINTS | That point upon axis of the eye which is sharply imaged on the retina when the accommodation is relaxed. The far point of an emmetropic eye lies at infinity. As the eyeball rotates in its socket, the visual axis also rotates. The far point, being upon the visual axis, may occupy any position upon the FAR POINT SPHERE. |
| FINING | Last step of grinding operation preparatory to polishing lens surfaces. |
| FLAT BLANK | A flat piece of glass suitable for grinding a lens. |
| FLINT GLASS | A glass of high refractive index containing lead, as distinguished from crown glass. |

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| FOCUS | The points to which the rays of a pencil of light converge, or from which they diverge. |
| FRONT | The main body comprising the "eyes" and "bridge" of spectacles. |
| FUSED GLASS | Glass welded together by heat. Term used to designate a Kryptok type bifocal. |
| GAUGE | An instrument used for checking the accuracy of curvatures and other linear dimensions. |
| GEOMETRICAL CENTER | The point lying in the middle of every diameter of a lens. Sometimes called the mechanical center as distinguished from the optical center. |
| GLAZING | Inserting or mounting lenses in frames. |
| GUARDS | Clips for attaching members of an eyeglass. |
| HIGH-BOW | Frames or mountings having bows - or endpieces - set above the mechanical center. |
| INDEX OF REFRACTION | The ratio of the sine of the angle of incidence to the sine of the angle of refraction of a ray of light traversing the surface between the two media; also the ratio of the speeds of light in the two media. |
| INFINITY | In optical science the term "infinity" is used to denote a distance so great that rays of light from the distance may be regarded as parallel. |
| INSET | The horizontal distance from the $90^{\circ}$ meridian of a bifocal lens to the geometrical center of the segment. |
| ISOTROPIC | Of equal refractive index: Optically uniform. |
| JUMP | That performance of objects when viewed through lenses having uneven surfaces, or through bifocal lenses at the margin of the joinder of the two fields. |
| KRYPTOK | A trade name for a fused bifocal lens. |
| LAP | A tool having a surface curvature which is imparted to a piece of glass by rubbing the two together with an abrasive between. |
| LEAD GLASS | Flint glass - high index. |
| LENTICULAR POWER | Lens power - power to converge or diverge light rays. |
| MAGNIFYING POWER | The ability of a lens to enlarge the image of an object. The magnification of an area is the square of the linear magnification. The magnification of a lens is found by dividing the distance of ten inches by the equivalent focal length of the lens. Example: A 2" lens has a linear magnifying power of $10 \div 2 = 5x$. |
| MEDIUM | Anything through which light passes. |

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| MENISCUS | Crescent shaped. In ophthalmic, practice, meniscus lenses are made with a base curve of 6 diopters. |
| MERIDIAN | A line at right angles to the optical axis of an optical system. |
| MONOCULAR | Pertaining to vision with one eye. |
| MOLDED BLANK | A pressing with a curved surface molded on each side, usually plus and minus 6.0 Diopter curve. |
| MOUNTING LINE | The line on which lenses are mounted in spectacles. |
| NEUTRALIZATION | The combining of two lenses of opposite powers so as to produce a resultant without power. |
| NORMAL | A line drawn at right angle to another line or to a surface; a perpendicular. |
| OBLIQUE | Slanting; not at right angles. |
| OPHTHALMIC | Pertaining to the eye. |
| OPTICAL CENTER | The point at which the line of centers cuts the lens. This is the thickest point on a convex lens and the thinnest point on a concave lens. |
| OPTICAL CROSS | Two lines intersecting in the center at right angles. |
| PADS | Guards or clips supporting the nose-piece. |
| PANTOSCOPIC | Tilted position of spectacles to compensate for various angles. |
| PCC | Perioscopic concave, a +1.25 base curve. |
| PCX | Periscopic convex, a -1.25 base curve. |
| PERISCOPIC | A spherical lens having a 1.25 D. base. |
| PITCH | A material used to hold the lens to the block during surfacing operations. It is composed ordinarily of a mixture of pitch and resin. |
| PLANE | Flat - without curvature. |
| PLANO-CYLINDER | A cylindrical lens having no spherical power. Usually has a plane base (plane cylinder), but may be toric with any base curve (Toric cyl.). |
| POINT | Unit of measure for lens thickness, calipering - usually 1/5 mm. |
| POWER - LENS | The ability of a lens to bring light to a focus. The unit of power of lenses is the diopter. |
| PRESBYOPIA | Old age sight; the loss of accommodative power of the eyes with advancing age. |

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| PRESCRIPTION | The formula for the lenses required by a patient. |
| PRISM | A wedge-shaped piece of glass having plano sides. Also understood as a point in a lens, outside the optical center, at which a radial displacement of a beam is produced. |
| PROTRACTOR | A device for indicating the center, axis or segment insert of a lens. It consists of a card or plate having a circle divided into $360^{o}$ and two major axes indicated at $180^{o}$ and $90^{o}$ for centering. |
| PUPILLARY DISTANCE | The distance in MM between the centers of the pupils in either distance or reading vision. |
| RADIUS | Half the diameter of a circle. The curvature of a surface is expressed in radius of curvature for precision work. |
| REFLECTION | The throwing back of light which is incident upon a surface. |
| RIDING BOW (R.B.) | A spectacle temple which rests on the ear and curls around it. |
| ROUGE | (The French word for Red). A polishing material, so named from red oxide of iron, though often applied to other polishing materials, such as "Black Rouge", "White Rouge", which are not red. |
| ROUGHING | Grinding with coarse abrasive to shape the lens surface. |
| R.P.M. | Revolutions per minute. |
| SEGMENT | The reading portion of a bifocal lens - usually in the form of a segment of a circle - may be round. |
| SEMI-FINISHED | A lens blank finished on one side only. |
| SIDES | Referring to temple pieces, or bows. |
| SPHERE | A surface, every point of which is equidistant from a point within called the center. |
| SPHERICAL ABERRATION | The defect of a lens due to its spherical surfaces, whereby rays of light incident upon the lens at different distances, from the optical axis are not convergent by the lens to a common focus. |
| STRAIN | In glass, an internal tension due to poor annealing, or to glass not of uniform coefficient of expansion. |
| STRAP THICKNESS | The thickness of a lens at the holes or at the point over which the strap of the frame fits. |
| STRIA (Pl. Striae) | A streak in glass caused by imperfect mixture of the ingredients. It is actually a variation in the refractive index. |
| SURFACING | The operation of grinding the surface of a lens. |
| TEMPLE | The side pieces of a spectacle, usually resting on the ears to support the frame. |
| TOOL | A shell or lap cut to a prescribed surface curvature and used for grinding or polishing a lens. |

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| TORIC | Pertaining to a torus or ring-shaped solid. One or both surfaces of a toric lens are sections of a torus. |
| TRANSPOSITION | Changing the curves of a designation of a lens without changing its refractive value. |
| TRUING | More often referring to the correction of inaccuracies of surfacing tools caused by previous uneven grinding. May apply to the straightening and lining-up of a pair of glasses. |
| VERTEX | That point at which the optical axis of a lens intersects the surface. |
| VERTEX POWER | The refractive power of a lens measured from its vertex to its principal focus. Vertex power is the significant fractor in determining the power of a correction lens. The unit of measurement of vertex power is the Vertex Diopter. |
| WAFER | (Segment) A very thin lens, which is cemented to a major lens to form a bifocal. |

PROCUREMENT OF SPECTACLES FOR MILITARY AND OTHER AUTHORIZED PERSONNEL

CONTENTS



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# PROCUREMENT OF SPECTACLES FOR MILITARY AND OTHER AUTHORIZED PERSONNEL

1. PREVIOUS DIRECTIVES RESCINDED. a. This pamphlet supersedes War Department Pamphlet No. 8-5, 30 April 1943; Section I, Circular No. 118, War Department 1943; Section II, Circular No. 131, War Department 1943; Circular No. 16, War Department 1944; Section IV, Circular No. 55, War Department 1944; and all previous instructions pertaining to the procurement of spectacles for military and other authorized personnel, including instructions issued by The Surgeon General in letters, radiograms, and teletype messages to the commanding generals of the service commands which are in conflict with this pamphlet.

b. The need for careful study of this pamphlet cannot be overemphasized, nor the importance of having this directive brought to the attention of the proper officers of the eye clinics as expeditiously as possible.

2. AUTHORITY. The authority for the procurement and repair of spectacles is as follows:

a. For United States Army personnel, including Army nurses, member of the Women's Army Corps, and other militarized female personnel of the Army.

(1) The Surgeon General will provide all military personnel with spectacles, when required, and will replace lenses and frames when either or both are damaged or lost in the performance of military duty.

(2) The Surgeon General will prepare such instructions as may be necessary and make such contracts and incidental arrangements as may be required. (See AR 40-1705.)

b. For authorized military personnel of any country the defense of which the President deems vital to the defense of the United States, when such authorized personnel are stationed within the forty-eight States and the District of Columbia, and military personnel, wherever located, of all co-belligerent countries who cannot reasonably obtain eyeglasses or replacement and repair thereof from facilities of their own country.

(1) For medical care and treatment of authorized personnel of any country whose defense the President deems vital to the defense of the United States when such care and treatment cannot be obtained from medical units of their own country. (See Military Appropriation Act, 1944, and S. G. O. Circular Letter No. 71, 17 July 1942, as amended by S. G. O. Circular Letter No. 178, 16 December 1942.)

c. For internees (prisoners of war and civilian enemy aliens undergoing internment by the War Department).

(1) Spectacles will be furnished for internees on the same basis as for United States troops. Cost incident thereto is chargeable to funds allocated to The Surgeon General.

d. Repair and replacement of eyeglasses for civilian employees of the War Department and Red Cross workers on military missions overseas.

(1) Necessary repair and replacement of eyeglasses belonging to civilian employees of the War Department and Red Cross workers on military missions overseas will be accomplished by repair and replacement units without cost to the individual. (See AR 40-590.)

3. DESIGNATION OF TYPES OF SPECTACLES. There are two types of spectacles issued by The Surgeon General; spectacles, commercial type (for ordinary wear), and

Eyeglasses, Gas Mask, M1 (for use beneath the gas mask). There have previously been issued spectacles, gas mask type, which have been found impracticable for wear beneath the gas mask because of the lack of perfect adjustment of the temple, which created discomfort and prevented gas tightness. Such spectacles which are outstanding, are authorized for use as an auxiliary spectacle for ordinary wear. Hereafter, repairs of the spectacles, gas mask type, will be limited to replacement of lenses only, and in instances where frames of this type spectacle are no longer serviceable, replacement will be made by issuance of spectacles, commercial type, in accordance with the provisions of paragraph 19. (See par. 26.) Hereinafter, the terms "spectacles, commercial type", "Eyeglass, Gas Mask, M1", and "Spectacles, gas mask type" will be used to designate the specific types of eyeglasses.

4. SPECIFICATIONS. a. Spectacles, commercial type, will conform to specifications issued by The Surgeon General, that is, such spectacles which are issued for ordinary wear and are of a standard, commercial, ful-vue design with metal rims and temples. If military or other authorized personnel desire eyeglasses not conforming to the above, such eyeglasses must be purchased by the personnel concerned and Government funds may not be used for either whole or part payment thereof.

b. The Eyeglass, Gas Mask, M1, will conform to specifications issued by The Surgeon General, that is, those presently being furnished by the Bausch & Lomb Optical Company or by any other optical company designated or authorized by The Surgeon General.

5. REFRACTION OF EYES. a. When ocular refraction is necessary and a medical officer is not available, request for authority to employ a civilian physician in the case of military and other authorized personnel on detached service with or without troops or at stations within the continental limits of the United States will be made to the commanding general of the service command concerned, in accordance with AR 40-505; for personnel on duty in the departments, to the department surgeon; and for personnel on duty in military establishments beyond the continental limits of the United States, to the force surgeon. The request for refraction will be approved in reasonable amount only and will include the adjustment of frames and fitting of spectacles when delivered. Authority for the employment of a civilian physician for refraction will not be granted to military and other authorized personnel who are under orders to report in the near future to a station where Army facilities are available, or who are absent temporarily for short periods from their proper stations where Army facilities are available.

b. For military and other authorized personnel on duty without troops in foreign countries, the following instructions will apply:

(1) Prior authority for the refraction of eyes will not be required. Accounts for such services at reasonable rates will be paid locally.

(2) Spectacles, commercial type, are authorized for such personnel and should be procured locally at reasonable rates, frames to be of metal and of durable construction with rims and temples, payment for which will be made locally. However, the above applies only if personnel are entitled thereto as provided by paragraph 19.

6. PROCUREMENT AND ISSUE OF SPECTACLES, COMMERCIAL TYPE, AT HOME STATIONS. Commanding officers of posts, camps, and stations are responsible for the procurement and issue of all spectacles, commercial type, at home stations as early as possible in the training period, to personnel entitled to these in accordance with paragraph 19, in order to preclude mass requests for ophthalmic examination and

procurement of spectacles, commercial type, at personnel replacement depots and staging areas in the event such personnel are ordered for oversea duty. Strict compliance with this paragraph is directed in order to avoid military personnel being delayed at ports of embarkation or proceeding to oversea destinations without the necessary eyeglasses in their possession.

7. ELIMINATION OF 1/8 DIOPTERS IN PRESCRIBING. Medical officers refracting personnel entitled to eyeglasses will not prescribe lenses in 1/8 diopter variations.

8. NEW LENSES FOR CHANGE OF PRESCRIPTION. Authority is granted to procure new lenses in instances where it is necessary to change the prescription.

9. SHIPMENT AND PACKING. a. In instances where spectacles, commercial type, are received by posts, camps, or stations within the continental limits of the United States after the individuals for whom they were intended have been assigned to oversea duty, packing for shipment to APO addresses will be as follows:

(1) Each individual pair of spectacles, commercial type, with case, will be inclosed in a spectacle mailing box for shipment showing on the face thereof, the name, serial number, grade, and APO address of the person for whom it is intended.

(2) The individual packages will then be placed in one large package or box and mailed to the respective APO address. The procedure outlined will eliminate unnecessary work on the part of the Army Postal Service and all shipments will be handled more expeditiously.

b. Installations within the zone of the interior should forward spectacles immediately upon their receipt when individuals for whom they are intended have been transferred to other stations.

c. In forwarding the eyeglass, gas mask, M1 to oversea installations, or to stations within the zone of the interior, care should be taken to carefully pack the eyeglasses in order to minimize breakages.

10. SPECTACLE MAILING BOXES. Mailing boxes for spectacles, commercial type, are stocked at the St. Louis Medical Supply Depot, St. Louis, Missouri, being identified as Item No. 9N071-00, and are to be used as containers for spectacles being mailed to personnel who have departed from their stations. Requisitions for this item will be forwarded to the Office of The Surgeon General, caution being used to requisition such moderate quantities as the demand necessitates. Spectacle mailing boxes will not be purchased from the optical companies under contract.

11. INQUIRY WHEN ADDRESS OF INDIVIDUAL IS UNKNOWN. When spectacles, commercial type, and/or eyeglass, gas mask, M1, are received after the individual for whom they are intended has been transferred to another station or discharged from the service, and every effort has been made without success to determine the correct address to which the spectacles or eyeglasses should be forwarded, inquiries for the correct address may be made of The Adjutant General, Washington 25, D.C.

12. CLASSIFICATION OF SPECTACLES, COMMERCIAL TYPE, SPECTACLES, GAS MASK TYPE, AND EYEGLASS, GAS MASK. a. Spectacles, commercial type, and spectacles, gas mask type, are classified as the individual's personal effects and will not be taken up on stock record account. The eyeglass, gas mask, M1, is not classified as the individual's personal effects, but will not be taken up on stock record account.

b. Spectacles, commercial type, will be forwarded to the home address of individuals for whom spectacles have been ordered but who have been discharged from the service prior to their receipt. Individuals discharged from the service will turn in the eyeglass, gas mask, M1, to their respective medical supply officer.

c. Upon an accumulation of a substantial number of spectacles, commercial type, or spectacles, gas mask type, which could not be forwarded to the individual concerned because of insufficient address, and/or the eyeglass, gas mask, M1, they will be forwarded to the Commanding Officer, Binghamton Medical Depot, Binghamton New York, inclosing therewith a memorandum stating that such spectacles could not be delivered or that the eyeglasses were turned in to the medical supply officer. Care should be taken to include with the spectacles the applicable prescription in order that the disassembly of such spectacles or eyeglasses may be expedited.

d. The Judge Advocate General has ruled that military personnel who, through design or willful negligence with the intent to temporarily incapacitate or unfit themselves for full military duty or to delay shipment overseas, destroy, lose, discard, or dispose of spectacles which have been issued to them for the purpose of insuring maximum individual efficiency in the performance of their military duties, are guilty of a violation of Articles of War 96 by reason of being guilty of disorders and neglects to the prejudice of good order and military discipline; and has suggested the following form of specification to be used for such offenses:

> In that _____did, at_____on or about _____19___, wrongfully (destroy) (lose) (discard) (dispose of) (spectacles, commercial type) (spectacles, gas mask type) (eyeglass, gas mask, M1) of the value of $____, furnished to him for use in the military service of the United States, thereby,(temporarily unfitting himself for the full performance of his military duties) (attempting to avoid important service). SPJGA 1944/1849, 15 February 1944.

If a medical officer has reason to believe that any individual is guilty of conduct as set forth above, he will submit the matter to the individual's commanding officer for such action as the latter may deem necessary.

13. CERTIFICATION OF "RECEIVING REPORT". a. All posts, camps, and stations presently or hereafter holding prescriptions due to hesitancy in signing the receipt of purchase certificate because of lack of information that the spectacles have actually been received by the personnel for whom they were intended will alter the aforementioned certificate as authorized in b below, affix signature, and forward the prescriptions to the fiscal branch office for processing.

b. The certificate of the "Receiving Report" will be changed from

> "* * * that they have been delivered to the above mentioned military personnel * * *"

to "* * * and will be delivered to the above military personnel * * *"

14. PERTINENT DATA TO BE TYPED ON PRESCRIPTION ORDER FORM. In preparation of the Spectacle Order Form for the procurement of spectacles, commercial type, or eyeglass, gas mask, M1, issued by the Government, the age of the individual concerned will be typed opposite the name, and the visual acuity (without glasses) of the right eye, left eye, and both eyes will be shown in the last column opposite "Dec. In." The letter "R" may be used for the right eye; "L" for left eye; and "B" for both eyes. It is further directed that information be typed on the Spectacle

Order Form showing whether the order is for an initial issue, replacement, or repair. These data are necessary for statistical purposes and will be entered on the Spectacle Order Form. When the Spectacle Order Form is revised, space will be provided for these data.

15. DAILY FORWARDING OF FORMS TO OPTICAL COMPANIES UNDER CONTRACT. a. Posts, camps, and stations procuring spectacles, commercial type, and/or eyeglass, gas mask, M1, will forward the Prescription Order Form to the branch office of the optical company concerned for processing at the end of each day and not accumulate such forms for transmittal at various periods. The practice of forwarding forms daily will expedite the delivery of spectacles.

b. Effective immediately, the priority classification numbering system as set forth in section II, Circular No. 131, War Department, 1943, is discontinued. This action is taken because experience has shown that requisitions bearing the lower priority classifications have remained outstanding for undue periods, and in view of the fact that spectacle requirements have become more stabilized, it is contemplated that the contractors will now be in a position to provide spectacle service within the maximum time limits specified in the respective contracts. Stations experiencing undue delays in the receipt of finished spectacles should bring these circumstances to the attention of the Office of The Surgeon General in order that corrective measures may be taken. In this connection, the maximum time clauses in the contracts relate to the time consumed at the service point and in determining whether undue delays have occurred, proper consideration should be given to transit time, time consumed within the stations for the forwarding of the prescriptions and deliveries of the finished spectacles and other pertinent factors.

16. CONTRACT INFORMATION NOT TO BE DIVULGED. Information in connection with contracts for the supply and repair of spectacles, commercial type, and eyeglass, gas mask, M1, for military and other authorized personnel, especially information in regard to the charges listed therein, will not be divulged to any military personnel, civilian employees of the United States Government, or any other individuals, with the exception of such military personnel and/or civilian employees of the United States Government as require the information for the execution of their duties.

17. PERMANENT RECORD OF PRESCRIPTION FOR SPECTACLES, COMMERCIAL TYPE, AND EYEGLASS, GAS MASK, M1. a. In order to facilitate the replacement or repair of lost or broken lenses and spectacle frames of the spectacles, commercial type, and the eyeglass, gas mask, M1, a permanent record will be made. In the case of officers, this data will be entered on W. D., M. D. Form No. 81 (Immunization Register), and in the case of enlisted personnel, on page 15, W. D., A. G. O. Form No. 24 (Service Record).

b. The following data will be made a part of such records for the spectacles, commercial type:

(1) When an individual is examined and in the opinion of the prescribing officer, spectacles, commercial type, are not required, entry will be made showing date of examination and stating that spectacles are not necessary for the efficient performance of military duty.

(2) If, after examination, it is found that spectacles are necessary, the following will be made:

(a) Prescription data.

(1) Date and place of refraction.
(2) Visual acuity of each eye and visual acuity, binocular, with and without correction.
(3) Correction required for each eye.
(4) Frame size.

(b) Issue data.

(1) Date spectacles ordered and date spectacles are issued.
(2) Number of pairs of spectacles issued to the individual.

c. The following data will be made a part of such records in the case of the eyeglass, gas mask, M1:

(1) Prescription data.
(a) Correction required for each eye.
(b) Position of eyeglass, gas mask, M1.
(c) Size of the proper fitting mask.
(2) Issue data.
(a) Date eyeglass, gas Mask, M1, ordered and date this item is issued.

d. A copy of the prescription and frame measurements of spectacles, commercial type and/or position of the eyeglass, gas mask, M1 will be given to the individual concerned, and he will be instructed to keep this copy on his person at all times. This is necessary to avoid refraction of eyes each time repair or replacement of spectacles becomes necessary. Eye clinics and station hospitals will use any prescription form they may have adaptable for this purpose.

18. PERSONNEL ENTITLED TO EYEGLASSES.

| | PERSONNEL | SPECTACLES, COMMERCIAL TYPE | EYEGLASS, GAS MASK, M1 |
|---|---|---|---|
| a. | Officers and enlisted men of the United States Army, including Army nurses, members of the Women's Army Corps, and other militarized female personnel of the Army. . . . . | If entitled in accordance with paragraph 19, two pairs of spectacles commercial type. | If entitled in accordance with paragraph 20, one pair of eyeglass, gas mask, M1. |
| b. | Warrant officers . . . . . | do. | Do. |
| c. | Cadets, United States Military Academy . . . . . | do. | Do. |
| d. | Aviation cadets; Army Air Forces. . . . . | do. | Do. |
| e. | Contract surgeons (full time) of the Army . . . . . | do. | Do. |
| f. | Prisoners (United States Army personnel) in military custody. | do. | Do. |
| g. | National Guardsmen in active Federal Service . . . . . | do. | Do. |
| h. | Reserve officers on extended active duty with the Army . . . | do. | Do. |
| i. | Reserve enlisted men on extended active duty with the Army. . . . . | do. | Do. |

| PERSONNEL | SPECTACLES, COMMERCIAL TYPE | EYEGLASS, GAS MASK, M1 |
|---|---|---|
| j. Retired military personnel on active duty with the Army . . . | If entitled in accordance with paragraph 19, two pairs of spectacles, commercial type. | If entitled in accordance with paragraph 20, one pair of eyeglass; gas mask, M1 . . ... |
| k. Members of the organized military forces of the Government of the Commonwealth of the Philippines in the service of the armed forces of the United States. . . . . | do. | Do. |
| l. Authorized military personnel of any country, the defense of which the President deems vital to the defense of the United States, when such authorized personnel are stationed within the fortyeight States and the District of Columbia, and military personnel, wherever located, of all cobelligerent countries who cannot reasonably obtain eyeglasses or replacement and repair thereof from facilities of their own country. | do. | If entitled in accordance with paragraph 20, and if issued a gas mask of the United States, Army type, one pair of eyeglass, gas mask, M1. . . . . |
| m. Such civilian employees of the War Department on military missions overseas as require eyeglasses for the performance of their duties. | Authorized for repair and replacement only. | If entitled in accordance with paragraph 20, and if issued a gas mask of the U. S. Army type, one pair of eyeglass, gas mask, M1.. . . . . |
| n. Such Red Cross workers on military missions overseas as require eyeglasses for the performance of their duties. . . . | do. | Do. |
| o. Internees (prisoners of War and civilian enemy aliens) undergoing internment by the War Department. | One pair of spectacles, commercial type, only if entitled in accordance with Paragraph 19. . . . . | Not authorized |

19. BASIS OF ISSUE OF SPECTACLES, COMMERCIAL TYPE. a. Effective immediately, the professional basis of issue of spectacles, commercial type, to authorized personnel will be as follows:

(1) To individuals requiring a correction of more than 1.00 diopter in any meridian in either eye.

(2) To other individuals who, in the opinion of the prescribing officer, require spectacles for the efficient performance of military duties, regardless of their correction.

b. Personnel entitled to spectacles will be issued two pairs of spectacles with the following exceptions:

(1) Prisoners of war and civilian enemy aliens will be issued only one pair each.

(2) In special cases where individuals are performing unusually close work for which bifocals are not adapted, the number of pairs of spectacles to be issued will be determined by the prescribing officer.

c. Examination for spectacles will be made as early as possible during the basic training period. This examination will include, but not necessarily be limited to, all individuals having a visual acuity of worse than 20/40 in either eye. The purpose of such examination is to avoid borderline cases reaching staging areas or ports of embarkation without complete examination having been made.

d. Prescribing officers are urged to exercise the discretionary basis of issue (a (2) above) with careful judgment in order that spectacles will be furnished only when they are necessary for the official performance of military duties.

e. When a prescription for spectacles is issued for an individual requiring a correction of 1.00 diopter or less in any meridian in each eye, a certification signed in autograph by the prescribing officer will be made on the Prescription Order Form setting forth in brief detail the reason for furnishing such correction at government expense.

f. The certification will be typed on all copies of the Prescription Order Form (the original only to be signed) as follows:

Spectacles are considered necessary for this individual because:_____
---

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(Name and grade)

g. This certification is not required for bifocal corrections; however, prescriptions calling for corrections of 1.00 diopter or less in any meridian in each eye incorporating a prism in either or both eyes will include this certification.

h. Prescribing officers are responsible for determining whether the individual has previously been furnished spectacles at Government expense before spectacles are ordered. This responsibility can be properly discharged by requiring this information in writing from the individual's commanding officer. (See par. 12d.)

i. Commanding officers of posts, camps and stations are responsible for establishing proper local procedure for the issuance of spectacles.

j. In the event an individual has in his possession a serviceable pair of metal rimmed spectacles, they may be considered as a second pair of spectacles, commercial type, and repair thereof may be accomplished in accordance with paragraph 24b.

20. BASIS OF ISSUE OF EYEGLASS, GAS MASK, M-1. a. The eyeglass, gas mask, M1, will be ordered only upon the authority of a prescription by the medical officer in charge. The Medical Department is the responsible agency charged with the proper fitting, issue, and repair of this item. Basis of issue will be only to personnel with a visual acuity of 20/70 or worse, with both eyes open (binocular vision) or to personnel requiring bifocal correction in order to properly perform their duties while wearing the gas mask.

b. The eyeglass, gas mask, M1, will be issued only to authorized personnel requiring this correction (a above) as follows:

(1) Training purposes for supervisory personnel and instructors only at the specific authorization of The Surgeon General.

(2) Personnel directed to be transferred to oversea replacement depots or ports of embarkation for oversea shipment will be fitted with and issued the eyeglass, gas mask, M1, prior to such transfer. Commanders responsible for preparing personnel for transfer will make every effort to secure this item for such personnel requiring this type eyeglass.

(3) Individuals in those units placed in A-2 priority for the issue of controlled items of equipment will be fitted with and issued the eyeglass, gas mask, M1, prior to movement to the staging area or port of embarkation. Unit commanders are responsible for making every effort to secure this item for all individuals under their command who require this type eyeglass.

c. Priority for issue of the eyeglass, gas mask, M1, is as follows:

(1) *Priority No. 1.* Individuals referred to b(2) above and individuals in units which are in equipment priority A-2a.

(2) *Priority No. 2.* Individuals in units which are in equipment priority A-2b.

(3) *Priority No. 3.* Individuals in units which are in equipment priority A-2c.

(4) *Priority No. 4.* Individuals referred to b(1) above.

d. The lack of the eyeglass, gas mask, M1, will not be sufficient cause to prevent the movement of an individual overseas.

e. In order to avoid subsequent refitting of this type spectacle, the following procedure is established.

(1) Each individual entitled to the eyeglass, gas mask, M1, as outlined in a and b above, will have issued to him, as expeditiously as possible, a new gas mask having an M3 facepiece, or a mask, gas, combat, when directed. However, until such time as the M3 facepiece is locally available, a new gas mask with M2A2 facepiece will be substituted. It is essential that a properly fitted gas mask be furnished. This means properly fitted for the installation of the eyeglass, gas mask, M1, as well as gas-tightness. Commanders will be responsible for the furnishing of a properly fitted facepiece to permit a satisfactory installation of the eyeglass, gas mask, M1, in accordance with recommendations of the prescribing medical officer. The commanding officer of the post, camp, or station will be responsible for establishing proper procedures to expedite the accomplishment of the above for all personnel located at such installations.

(2) The individual entitled to the eyeglass, gas mask, M1, will carry his properly fitted facepiece overseas. To accomplish this, the individual will carry his complete mask with him to the port of embarkation. The port commander will be responsible for accomplishing the following exchanges:

(a) In such cases when mask, gas, service, lightweight, is authorized in pertinent movement orders, the port Chemical Warfare Service officer will properly install a new hosetube, canister and carrier on the facepiece fitted with the eyeglass, gas mask, M1, in exchange for the old hosetube, canister, and carrier.

(b) In the event the individual has in his possession an M3 facepiece, an exchange of the hosetube, canister, and carrier will be made when determined necessary by the port Chemical Warfare Service officer. In all cases the port Chemical Warfare Service officer will insure proper tightness of the union between facepiece and hosetube.

f. The various positions of the lens within the eyeglass, gas mask, M1, should usually make unnecessary any decentration of lenses in excess of 2½-mm in either the vertical or horizontal meridian. Prescriptions calling for decentration in excess of 2½-mm probably indicate that the incorrect position of the eyeglass, gas mask, M1, has been prescribed or that improperly fitted gas mask has been issued. The supplier is authorized to return for correction those prescriptions which evidence that decentration could have been minimized through the use of a different position of the eyeglass, gas mask, M1.

g. At the time of issuance of the eyeglass, gas mask, M1, to military or other authorized personnel, it will be the responsibility of the medical officer in charge to instruct the recipient of the eyeglasses in the technique of inserting and removing this item from the gas mask. This is necessary in the event the eyeglasses or the eyepieces of the gas mask require cleaning. The individual will be cautioned that the eyeglass, gas mask, M1, will not be removed for any other reason.

h. An excessive number of breakages of the lenses are being experienced at various installations, and it has been determined that the majority of such breakages occur from excessive pressure of the eyewire on the lens. In this connection, attention is directed to paragraph 7, page 2a, of the "Instruction Manual for Fitting Eyeglass, Gas Mask, M1", which states that after rotating the lens to the proper axis, the eyewire screw should be tightened and then backed off one-half turn to relieve excessive pressure.

21. TINTED AND ESPECIALLY SHAPED LENSES. Tinted and especially shaped lenses are not authorized except in connection with repairs as covered by paragraph 24b.

22. LENSES OTHER THAN THOSE SUPPLIED UNDER EXISTING CONTRACTS. In the event a lens of a special type is required other than the type supplied under existing contracts, authority for such purchase will be requested of The Surgeon General through the commanding general of the service command setting forth in detail the existing circumstances which necessitate such a special lens.

23. FRAMES OF SPECTACLES FOR ORDINARY WEAR OTHER THAN THOSE SUPPLIED UNDER EXISTING CONTRACTS. In the event a frame is required other than the type issued under the existing contracts for spectacles, commercial type, due to an idiosyncrasy of the skin, authority for procurement of such special frame will be requested of The Surgeon General through the commanding general of the service command setting forth detailed information concerning the existing circumstances.

24. REPLACEMENT AND REPAIR OF SPECTACLES, COMMERCIAL TYPE. a. Before spectacles, commercial type, are replaced or repaired, the responsible officer will assure himself that loss or breakage was in the performance of military or official duty and that no carlessness was involved. (See par. 12d.) Complete replacement

or repair will be limited to those individuals entitled to spectacles in accordance with the basis of issue as set forth in paragraph 19.

b. Repairs of serviceable, metal-rimmed spectacles with temples of durable construction, decision as to durability to rest with the responsible medical officer (Par. 19j) will also be made at public expense and will be governed by the following

(1) If one lens is broken, replacement in kind will be made.

(2) If both lens are broken, replacement will be made with such lenses provided under the existing contracts (untinted).

(3) If the frame is broken, repair will be made provided that the cost will not exceed the charge of a complete pair of spectacles issued by the Army.

c. Experience has indicated that individuals are purchasing zylonite and shell frames and are being issued lenses at public expense for insertion therein. This practice is not authorized and will be discontinued immediately.

25. REPLACEMENT AND REPAIRS; EYEGLASS, GAS MASK, M1. Before the eyeglass, gas mask, M1 is replaced or repaired, the responsible officer will assure himself that loss or breakage was in the performance of military or official duty and that no carelessness was involved. (See par. 12d.)

26. REPLACEMENT AND REPAIRS; SPECTACLES, GAS MASK TYPE (TO BE USED AS AN AUXILIARY PAIR OF COMMERCIAL TYPE SPECTACLES). a. In case of losses or breakages, replacement in whole of the spectacles, gas mask type, or repair of the frame or replacement of the temple will not be made but replacement will be effected through issuance of spectacles, commercial type, in accordance with paragraph 19.

b. Replacement of lenses of the spectacles, gas mask type, will be made only after the responsible officer has assured himself that breakage was in the performance of military or official duty and that no carelessness was involved. (See par. 12d.) Replacement of lenses will be limited to those individuals entitled to spectacles, commercial type, in accordance with the basis of issue as set forth in paragraph 19. Lenses will be procured under existing contracts for spectacles, commercial type.

27. OPTICAL REPAIR AND REPLACEMENT UNITS. Through the medium of mobile and portable optical repair units, repair and replacement facilities are available in the various theaters of operation. The optical repair facilities are attached to medical supply depots and whenever possible should be utilized. These facilities, however, are generally limited to the replacement and repair of spectacles of the type covered by The Surgeon General's specifications.

28. FITTING AND REPAIR CASES FOR SPECTACLES, COMMERCIAL TYPE. The following fitting and repair case is presently stocked and is issued upon requisition to The Surgeon General: Item 36275, Case, Spectacle, Fitting and Repair. In the event fitting and repair cases in excess of authorized allowances are necessary due to the volume of work, requisitions should be directed to The Surgeon General setting forth therein the number of spectacle requisitions per month being initiated at the particular installation.

29. FITTING CASE FOR EYEGLASS, GAS MASK, M1. The following fitting and repair case for the eyeglass, gas mask, M1, is presently stocked and is issued upon requisition to The Surgeon General: Item 93540, Case, Fitting, Eyeglass, Gas Mask,

M1. This fitting case should be requisitioned by only such stations which have occasion to order the eyeglass, gas mask, M1, in accordance with the basis of issue as set forth in paragraph 20. In the event an additional fitting case for the eyeglass, gas mask, is necessary due to the abundance of work being performed at the particular installation, requisition should be directed to The Surgeon General setting forth therein the volume of work which is being performed over a monthly period.

30. REPLACEMENT OF USED OR DAMAGED ARTICLES OF ITEM 36275, CASE, SPECTACLE, FITTING AND REPAIR; ITEM 93540, CASE, FITTING, EYEGLASS, GAS MASK, M1; AND ITEM 30900, CASE, TRIAL LENS. a. The following procedure is applicable for stations within the continental limits of the United States and those oversea installations procuring spectacles under the spectacle contracts entered into by The Surgeon General:

(1) Components of Item 36275 and Item 30900 are to be procured under the commercial type spectacle contract with the American Optical Company, Southbridge, Mass. Copies of this contract are being distributed to all installations having occasion to procure the commercial type spectacles, including those installations procuring commercial type spectacles from the Bausch & Lomb Optical Company, Rochester, New York; the latter, however, for the specific purpose of procuring components of the aforementioned items.

(2) Components of Item 93540 are to be procured under the contract for the eyeglass, gas mask, M1, with the Bausch & Lomb Optical Company, Rochester, New York. Copies of this contract are being distributed to all installations having occasion to procure the eyeglass, gas mask, M1.

b. Installations beyond the continental limits of the United States will requisition components of the above mentioned items in the usual manner.

31. STATIONS WITHIN CONTINENTAL LIMITS OF UNITED STATES. a. Medical officers at installations within the continental limits of the United States will placeorders for spectacles, commercial type, and for eyeglass, gas mask, M1, as heretofore on the Spectacle Order Form.

b. Instructions attached to the copy of the respective optical contracts set forth definite procedures in procuring spectacles, commercial type, and eyeglass gas mask, M1.

WAR DEPARTMENT,
Washington 25, D.C., 20 June 1944.

## PROCUREMENT OF SPECTACLES FOR MILITARY AND OTHER AUTHORIZED PERSONNEL

War Department Pamphlet No. 8-5, Procurement of Spectacles for Military and Other Authorized Personnel, is published for the information and guidance of all concerned.

(A. G. 413.75 (15 Jun 44).

By Order Of The Secretary Of War:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:
J. A. ULIO,
Major General;
The Adjutant General.

A TRUE COPY

S. E. LaRose
1st Lt., Med. Adm. C.